

**UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS**

LJM PARTNERS, LTD.,

Plaintiff,

v.

JOHN DOES,

Defendants.

Case No. 19-cv-368

COMPLAINT

JURY TRIAL DEMANDED

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I. INTRODUCTION

1. This case is brought under the Commodities Exchange Act (“CEA”), 7 U.S.C. § 1, *et seq.*, for losses suffered when Plaintiff LJM Partners, Ltd. purchased and/or sold options on S&P 500 futures and/or E-mini S&P 500 futures (“E-mini futures”) on the Chicago Mercantile Exchange (“CME”) on February 5, 2018 and February 6, 2018 at prices that were inflated as a result of market manipulation committed by as-yet unidentified John Doe Defendants.

2. Plaintiff LJM Partners, Ltd. (“LJM”) was a Commodity Trading Advisor and Commodity Pool Operator that managed a total of approximately 50 accounts (including commodity pools and individual accounts) on behalf of investors, under a variety of approaches (such as Moderately Aggressive and Aggressive). Regardless of the specific approach, all of LJM’s trading strategies were focused on the purchase and sale of options on S&P 500 futures, which LJM would typically hold until expiration, thereby collecting a premium from the buyers of these options as the funds’ profit and/or collecting the settlement value of any options LJM held that were “in-the-money” at the time of settlement.

3. LJM had carefully designed all of its trading and risk strategies so as to be robust enough to survive market downturns, and had itself successfully emerged from large downturns in the S&P 500 in October 2008 and August 2011 with manageable losses (and, in many other cases, beating the market during downturns). As a result, at the close of trading on Friday, February 2, 2018, LJM collectively managed approximately \$516.9 million in net assets.

4. On February 5, 2018, the S&P 500 suffered a one-day decline of 113.19 points, or approximately 4.1%. This loss, while significant, was hardly unprecedented – it was not among even the top 20 single-day percentage declines in the history of the S&P 500 Index, and this decline was not the result of any macroeconomic or world event (such as a downgrading of U.S.

government debt or a major financial services firm bankruptcy). It was, in other words, the type of decline that would have certainly caused LJM losses, but those losses should have been survivable in a properly functioning and fair market, as LJM had survived similar (or even worse) such declines in the S&P 500 in the past.

5. However, the events of February 5, 2018 (and early February 6, 2018) proved catastrophic to LJM. By the close of trading on February 6, 2018, the net assets managed by LJM were just \$70.5 million – a loss of approximately \$446.8 million from its February 2 close, or a loss of 86.5% of the assets managed by LJM. A one-day 4.1% decline in the S&P 500 unconnected to any fundamental economic or world event should not have caused these precipitous losses.

6. Instead, the major contributor to LJM's losses on February 5-6, 2018 was an unprecedented increase in implied volatility – an increase that subsequent investigations by LJM and others have discovered was artificially manipulated and created by John Doe Defendants, to profit from their positions in volatility-linked derivatives.

7. The Volatility Index, known under its ticker symbol "VIX," is a benchmark index created by the Chicago Board Options Exchange ("CBOE"). Introduced in 1993, the VIX purports to measure the implied volatility of large cap U.S. stocks over 30 days in the future. Since it first became tradeable beginning in 2004 via VIX Futures, VIX Options, VIX-linked exchange traded products ("VIX ETPs"), and so-called inverse VIX ETPs (products designed to move inversely to movements in the VIX), the VIX has seen its trading volume skyrocket, and is now responsible for billions of dollars in financial derivatives.

8. Often dubbed the stock market's "fear index" or "fear gauge," the VIX is calculated based on real-time prices of certain put and call options on the Standard & Poor's 500

Index (“SPX Options”) and is designed to reflect investors’ consensus view of near-term future expected stock market volatility. The VIX estimates expected volatility in the S&P 500 by averaging the weighted prices of SPX Options over a wide range of out-of-the-money strike prices. Prices of SPX Options are correlated with volatility — as investors’ expectation of volatility in the near future rises/falls, the price of out-of-the-money SPX Options correspondingly rises/falls to reflect the respective increased/decreased risk of those options due to wider/narrower expected fluctuations in the S&P 500. Therefore, expected volatility is calculated by the VIX in reference to out-of-the-money SPX Options prices.

9. The SPX Options used to calculate the VIX are directly correlated and move in tandem with the options on S&P 500 futures and E-mini futures that LJM traded on the CME on February 5-6, 2018. Thus, any manipulation in the prices of SPX Options at a certain strike price on the CBOE would directly cause corresponding manipulation in the same direction to the prices of options on S&P 500 futures and E-mini futures at that same strike price on the CME, and any manipulator engaging in such conduct would know that the effects of their manipulation would be felt in such correlated instruments on other exchanges.

10. On February 5, 2018, as the S&P 500 declined by 4.1%, the VIX increased from 17.31 to 37.32 – an increase of 116%. This was the largest single daily percentage increase ever recorded in the VIX, and the single greatest daily move in the history of the VIX. The February 5, 2018 VIX settlement of 37.32 equates to 13.7 standard deviations from the mean settlement price during the 12-month period preceding February 5, 2018 – a spike so statistically unlikely that it cannot be rationally explained within the confines of a fair and functional market, and which was exponentially greater than previous increases in the VIX seen on other days where the S&P 500 suffered 4% or greater declines.

11. LJM's investigation has found that this spike in the VIX was not the result of legitimate market forces, but instead resulted from manipulation in violation of the CEA, undertaken by a select group of financial institutions and trading firms (the "John Doe Defendants") on February 5, 2018 as described herein. On information and belief, these John Doe Defendants had sizeable positions in VIX-linked financial instruments and derivatives (including but not limited to VIX Futures, VIX Options, VIX ETPs, and inverse VIX ETPs) that stood to profit from an increase in the VIX, with those positions becoming more profitable the higher the VIX reached.

12. By posting inflated bid-ask prices for various strike prices of SPX Options – prices that were not related to any legitimate positions they held or wished to hold, and which they did not intend in good faith to trade on – the John Doe Defendants were able (at little or zero cost or risk to themselves) to increase the bid-ask midpoint prices for SPX options used in the calculation of the VIX on February 5, 2018. This, in turn, artificially elevated the VIX settlement level on that date, allowing the John Doe Defendants to profit from their much larger positions in VIX-linked financial instruments and derivatives.

13. Essentially, the John Doe Defendants used the SPX options market and their CBOE-approved access to that market to manipulate the VIX Index calculation on February 5, 2018 higher than it otherwise would have been given prevailing market conditions and, by doing so, generated massive profits for their much larger positions in VIX Futures, VIX Options, and VIX ETPs.

14. The result of this manipulation of the bid-ask prices of SPX Options did not only artificially increase the VIX, however. It also artificially manipulated the price of other instruments directly correlated with SPX Options – including the options on S&P 500 futures

and E-mini futures that LJM traded in on February 5-6, 2018. These manipulations in prices of options on S&P 500 futures and E-mini futures harmed LJM twofold: they both forced LJM to deploy risk management trading strategies that otherwise never would have been triggered in a non-manipulated market based on the false price movements, and they forced LJM to trade in these instruments at artificially high prices. The result was that LJM was forced, by John Doe Defendants' manipulation, to realize hundreds of millions of dollars of losses on February 5-6, 2018 that it otherwise would not have suffered absent this manipulation.

15. Because CBOE has chosen to keep the trading of SPX Options anonymous, LJM is not yet able to identify the precise number and identity of the John Doe Defendants who engaged in manipulation of the VIX through artificially inflated bid-ask prices for out-of-the-money SPX Options on February 5-6, 2018. However, CBOE possesses that information — indeed, it is required to maintain it under the Commodity Exchange Act, 7 U.S.C. §7(d) — and LJM will be able to use that information to identify the John Doe Defendants through discovery.

16. John Doe Defendants' conduct caused actual damages to LJM in violation of the Commodity Exchange Act, 7 U.S.C. §1 *et seq.* LJM seeks damages caused by John Doe Defendants' manipulation and Defendants' violations of the Commodity Exchange Act, including treble damages and injunctive relief.

II. PARTIES

17. Plaintiff LJM Partners, Ltd. is an Illinois corporation with its principal place of business in Chicago, Illinois.

18. On February 5 and 6, 2018, LJM purchased and/or sold options on S&P 500 futures and/or E-mini futures on the CME. As a direct and proximate result of John Doe Defendants' manipulative conduct and unlawful acts, LJM and the funds it managed were

injured in their business or property by buying and/or selling these instruments at a loss due to the artificial and manipulated prices caused by John Doe Defendants, costing LJM and the funds it managed hundreds of millions of dollars in losses.

19. John Doe Defendants are those financial institutions that manipulated the VIX and the price of SPX Options on February 5-6, 2018, so as to influence the value of the VIX, and, relatedly, profit off of their positions in VIX Options, VIX Futures, VIX ETPs, and/or inverse VIX ETPs.

20. John Doe Defendants' manipulation of the VIX and SPX Options foreseeably and directly caused artificial prices to exist for the options on S&P 500 futures and E-mini futures that LJM traded in on February 5-6, 2018. By trading in these instruments at artificial prices, LJM suffered losses that it would not have suffered absent John Doe Defendants' manipulation.

21. LJM will be able to identify the John Doe Defendants through discovery of trading records in the possession of CBOE that CBOE is required to maintain under the Commodity Exchange Act, including but not limited to, Order Entry Operator identifications, Tag 50 IDs, User Assigned IDs, and Clearing Information.

III. JURISDICTION AND VENUE

22. This court has subject matter jurisdiction over this action pursuant to Section 22 of the Commodity Exchange Act (7 U.S.C. § 25), and 28 U.S.C. §1331.

23. This Court has personal jurisdiction over each Defendant. All John Doe Defendants are reasonably believed to have: (1) transacted business in the United States, including in this District; (2) substantial contacts with the United States, including in this District; and (3) committed substantial acts in furtherance of the claims herein in the United States, including in this District, including the manipulation of the prices of SPX Options and

correlated options in S&P 500 Futures and E-mini futures traded in this District. In addition, John Doe Defendants' conduct was directed at, and had the intended effect of, causing injury to persons residing in, located in, or doing business in the United States, including in this District, and LJM's claims arise out of the John Doe Defendants' conduct.

24. Venue is proper in this District under 28 U.S.C. §1391(b), (c), and (d). Defendants resided, transacted business, were found, or had agents in this District; a substantial part of the events giving rise to LJM's claims arose in this District; and a substantial portion of the affected interstate trade and commerce described herein has been carried out in this District.

25. The activities of Defendants were within the flow of, were intended to, and did have a substantial effect on the interstate commerce of the United States.

IV. FACTUAL ALLEGATIONS

A. OVERVIEW

26. The central theory of this case is straightforward. On February 5, 2018, while the S&P 500 was suffering a significant (but not aberrant) 4.1% decline in value, John Doe Defendants took the opportunity of this decline to manipulate the market's leading measure of volatility, the VIX, upwards, in order to increase profits on large positions they had taken in VIX options, VIX futures, VIX ETPs that were long on implied volatility (i.e., betting that implied volatility would increase), and on short positions on "inverse VIX" ETPs (which would increase in value as implied volatility increased).

27. The primary means by which the John Doe Defendants accomplished this manipulation was by placing artificial and manipulative bid-ask quotes on out-of-the-money SPX Options traded on the CBOE.¹ Because the VIX formula is based on the prices and/or

¹ The evidence that LJM has been able to adduce thus far of manipulation is limited to SPX Options manipulation. LJM believes it is possible that Defendants' manipulation of the VIX on February 5, 2018

midpoint of bid-ask spreads of out-of-the-money SPX Options, by placing ever widening bid-ask quotes on SPX Options, the John Doe Defendants were able (at little or no cost to themselves) to increase prices and/or the midpoint of bid-ask spreads on out-of-the-money SPX Options, which therefore increased the VIX, and secured increased profits on the John Doe Defendants' long positions in VIX options, VIX futures, and VIX ETPs, and short positions on inverse VIX ETPs.

28. However, this manipulation in the price of SPX Options did not merely result in manipulating VIX upwards. It also created artificial prices in highly-correlated S&P 500 derivatives, including (a) options on S&P 500 futures and (b) E-mini S&P 500 futures, both of which are traded on the CME, thereby violating the Commodity Exchange Act. LJM was therefore harmed when it traded these instruments on February 5-6, 2018 in response to and at prices that were artificial due to the manipulation by John Doe Defendants.

29. In the following sections, this Complaint will: (a) provide a background on and discuss the interrelated nature of SPX Options, options on S&P 500 futures, and E-mini S&P 500 futures; (b) discuss the VIX, and the role SPX Options play in calculating the VIX; (c) describe how the VIX can be manipulated, evidence that such VIX manipulation had occurred prior to February 5, 2018, and how VIX manipulation would impact the financial instruments that LJM traded in; (d) describe LJM's approach to trading, its history, and its positions prior to February 5, 2018; (e) discuss the market movements of February 5-6, 2018, how they impacted LJM's positions, and the losses LJM suffered on February 5-6, 2018; (f) demonstrate via LJM's own analysis that the historic and unprecedented spike in volatility on February 5, 2018 was a result

may have also involved manipulative bids or trades on VIX Futures and/or other instruments designed to similarly manipulate the VIX upwards. Should additional evidence be discovered that supports LJM's information and belief as to manipulation in other non-SPX Options instruments causing LJM losses, it will amend its complaint accordingly to include such evidence.

of manipulation by the John Doe Defendants, and that this manipulation was the driving force behind the magnitude of LJM's losses.

B. BACKGROUND ON THE FINANCIAL INSTRUMENTS INVOLVED IN THIS LITIGATION

1. Futures and Options Contracts Generally

30. An option contract is a type of financial derivative that gives the buyer the right – but not the obligation – to either buy (in the case of a “call option”) or to sell (in the case of a “put option”) a particular commodity or financial instrument at a predetermined price, at or before a specified time in the future (the “expiration date”). The agreed price is generally known as the “strike price.”

31. A “put” or “put option” is a financial contract which gives the owner the right, but not the obligation, to sell an agreed quantity of a particular commodity or financial instrument, at the strike price, by or on the expiration date. A “call” or “call option” is a financial contract which gives the owner the right, but not the obligation, to buy an agreed quantity of a particular commodity or financial instrument at the strike price, by or on the expiration date.

32. In terms of when a given option can be exercised/settled, there are two different approaches. A European option may be exercised or settled only at the expiration date of the option (i.e., at a single pre-defined point in time). An American option, on the other hand, may be exercised at any time before the expiration date.

33. In terms of settlement, options can be settled in one of two ways.

34. A physically settled option requires physical delivery of the underlying commodity or financial instrument on settlement. Many stock options are physically settled, meaning settlement requires actual delivery of the stock to the holder if she exercises the option.

For example, an option for corn might require physical delivery of the quantity of corn required in the contract.

35. A cash-settled option, in contrast, results in a cash payment to the holder of the option based on prevailing market values for the underlying product of instrument at the time of settlement, rather than delivery of the product or instrument.

36. Whether an option is exercised depends on whether it is “in-the-money” or “out-of-the-money.” An in-the-money call option is one where the strike price is below the current price of the underlying asset. For example, if an option holder owns a call option giving the right to buy a bushel of corn at a price of \$3, and the market price for the bushel of corn is currently \$5, the call option is in-the-money – because the option holder could make \$2 by exercising the option to buy the bushel of corn for \$3 and immediately sell it for \$5. An in-the-money put option is one where the strike price is above the current market price of the underlying asset. Thus, if an option holder owns a put option giving the right to sell a bushel of corn at a price of \$7, and the market price for a bushel of corn is currently \$5, the put option is in-the-money – the option holder could make \$2 by purchasing a bushel of corn for \$5 and then exercising the put option to immediately sell that bushel of corn for \$7.

37. An out-of-the-money call option is one where the strike price is above the current price of the underlying asset. In the earlier example, if an option holder held a call option giving the right to buy a bushel of corn at \$6 but the market price for the bushel of corn is currently \$5, that call option is out-of-the-money (the option holder would not exercise it, since they could buy the bushel of corn more cheaply at the market price). Likewise, an out-of-the-money put option is one where the strike price is below the current market price of the underlying asset. Thus, if an option holder holding a put option giving the right to sell a bushel of corn at \$4 but the current

market price of a bushel of corn is \$5, that put option is out-of-the-money (because the option holder would not exercise it, since they could sell the bushel of corn at the current market price and make more money).

38. Whether an option is in or out-of-the-money depends on the relevant prevailing market price at the time of the settlement of the option – the at-the-money price. In the case of the bushel of corn above, the at-the-money price is \$5, which is the prevailing market price of a bushel of corn at the time of settlement. An option can be in- or out-of-the-money at one point in time and just the opposite at the time of the settlement of the option – a put option to sell a bushel of corn at \$3 is out-of-the-money when the at-the-money price is \$5, but in-the-money if the price were to swing below \$3.

39. Futures contracts are similar to options, except that they create an obligation (and not merely the optional right) to buy or sell a particular commodity or financial instrument, at a predetermined price, on a fixed date in the future (the expiration date). Like options, futures contracts can also be cash-settled, instead of requiring physical delivery of the underlying commodity or instrument on the expiration date.

40. The price paid by the buyer of an option and received by the seller of the option is the premium. Generally speaking, the seller of an option profits if the option is worth less at expiration than the premium received. This is the case if the option is out-of-the-money at expiration, if the option is at-the-money at expiration, or if the option is in-the-money at expiration by an amount that is less than the premium received.

2. The S&P 500 Index

41. The Standard & Poor's 500 Index (or S&P 500) is a capitalization-weighted index of 500 U.S. stocks from a broad range of industries that have common stock listed on the NYSE

or NASDAQ. The component companies included in the index are selected by a committee of the S&P Dow Jones Indices based on eight primary criteria (market capitalization, liquidity, domicile, public float, sector classification, financial viability, length of time publicly traded, and stock exchange), and the impact of an individual component's price change proportional to the issue's total market value (share price multiplied by the number of shares outstanding).

42. The S&P 500 is widely regarded (along with the Dow Jones Industrial Average and the Russell 1000) as one of the leading benchmarks of the overall U.S. stock market.

43. Because there is no tangible "S&P 500" that can be physically delivered, financial derivatives (such as futures and options) use alternative settlement procedures. For example, options on the S&P 500 index (i.e. SPX options) and futures on the S&P 500 index are cash-settled, using the value of the S&P 500 at settlement/exercise as the underlying value to determine whether a future or option contract based on the S&P 500 is in or out-of-the-money and if a cash payment is made. Options on futures are settled such that option contracts which are in-the-money at expiration result in a corresponding position in S&P futures. If a call option in S&P futures is in-the-money at expiration the owner of the option receives a long position in the S&P futures at a price equal to the strike price of the option. If a put option in S&P futures is in-the-money at expiration the owner of the option receives a short position in the S&P futures at a price equal to the strike price of the option.

44. While there are many types of S&P 500 financial derivatives, there are three that are relevant to this Complaint.

3. SPX Options

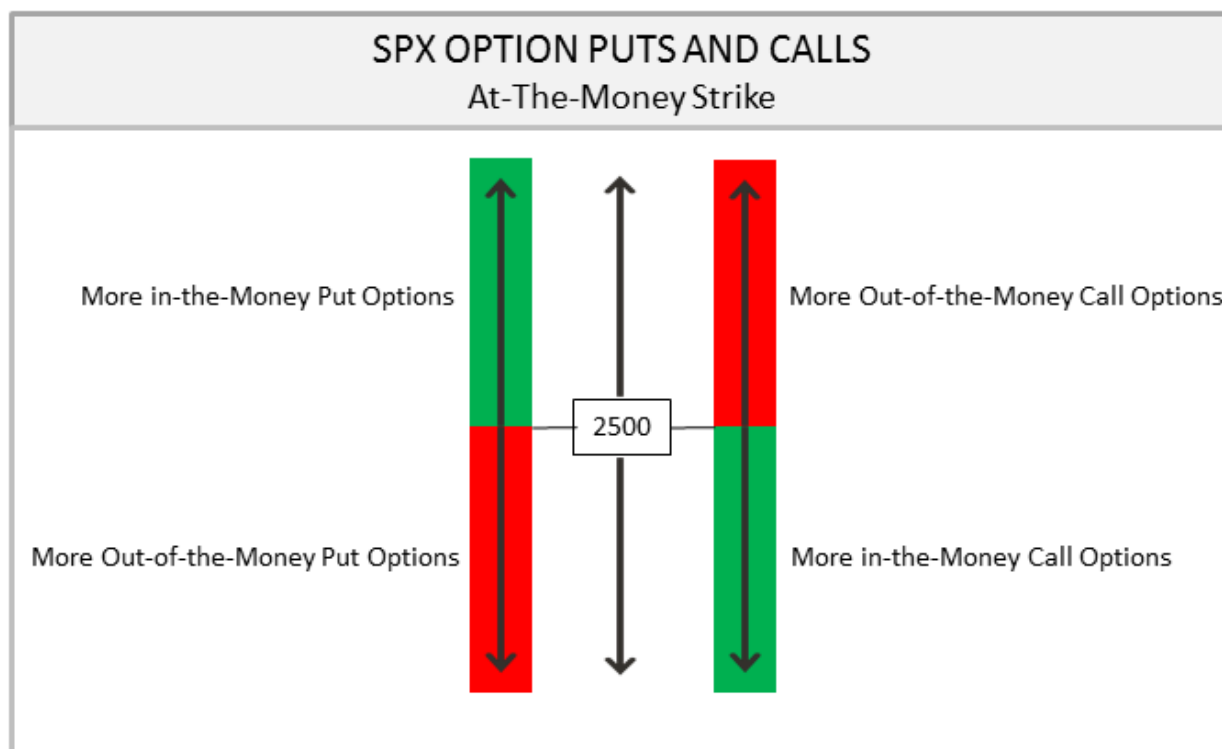
45. *First* are SPX Options. SPX Options are available for trading solely on the CBOE, and the CBOE markets SPX Options as its "flagship contract," and as "the index option

of choice for institutional investors trading large and complex [S&P 500 options] orders.”² CBOE provides a range of SPX Options, including SPX Options with A.M. settlement, with P.M. settlement, weekly options, and end-of-month options. SPX Options are European options, and can only be exercised at expiration.

46. Like any other option, SPX Options can be either call or put options. They also can be in- or out-of-the-money at any given point in time, depending on the market’s current expectation of the S&P 500 Index’s value in the future relative to the expiration date of the SPX Option. For example, the at-the-money price for an SPX Option that expires in 30 days reflects the market expectation of the level of the S&P 500 in 30 days’ time.

47. Because they are cash-settled, there is a spectrum of in-the-money and out-of-the-money SPX options, as seen in the diagram below (using 2500 as the hypothetical at-the-money strike price). SPX Option puts that have lower strike prices are more out-of-the-money because the market is less likely to decline to those strike prices (and thus the right to sell at that lower price compared to the current strike price is less likely to be in-the-money). Similarly, but on the opposite side, SPX Option calls that have higher strike prices are more out-of-the-money because the market is less likely to rise to those higher strike prices (and thus the right to buy at that higher price compared to the current strike price is less likely to be in-the-money):

² CBOE, *S&P 500 Index*, <http://www.cboe.com/products/stock-index-options-spx-rut-msci-ftse/s-p-500-index-options/s-p-500-index>.



4. Options on S&P 500 Futures

48. **Second** are options on S&P 500 futures. Options on S&P 500 futures are traded on the CME, and are considered a second derivative, as they are an option on an S&P 500 futures contract rather than an option directly on the underlying S&P 500 index itself. The underlying instrument for each options contract is one S&P 500 futures contract. Should an option be in-the-money at expiration, the owner of the option would receive an appropriate futures position, which would then immediately settle to cash. The owner of a call option would receive a long position in the futures with a futures price equal to the strike price of the call option, which would then immediately settle to cash. The owner of a put option would receive a short position in the futures with a futures price equal to the strike price of the put option, which would then immediately settle to cash. The seller of the option would receive the opposite position (i.e. a short position in the case of a call option and a long position in the case of a put option), which

would likewise immediately settle to cash. Because of this final settlement methodology, SPX options and options on S&P 500 futures are essentially equivalents.

49. The CME offers Standard options on S&P 500 Futures (that are American Style options), as well as end-of-month, weekly Wednesday, and weekly Friday options on S&P 500 Futures (that are European style options). Like any other option, options on S&P 500 futures can be puts or calls, and in or out-of-the-money at any point in time, depending on the market's current expectation of the value of an S&P 500 future (which itself is based on the expected future value of the S&P 500).

5. E-mini S&P 500 Futures

50. *Third* are E-mini S&P 500 futures, or E-mini futures. E-mini futures are traded on the CME, and are a smaller, one-fifth sized version (with a contract unit equal to \$50 multiplied by the S&P 500 index value) of the full S&P 500 futures contract (which has a contract unit equal to \$250 multiplied by the S&P 500 index value).

51. E-mini futures are cash-settled, and among the most liquid financial instruments traded on the CME.

6. Correlation between SPX Options, options on S&P 500 Futures, and E-mini Futures

52. Because all three instruments – SPX Options, options on S&P 500 futures, and E-mini futures – are based on the same underlying index (the S&P 500), they are highly correlated and move in tandem. As one brokerage firm has noted in reference to SPX Options and E-mini futures, “SPX Option market makers factor the cost of carry and dividends out of the E-mini S&P 500 future, and use that to come up with the prices of the SPX options.”³ Another financial

³ <https://tickertape.tdameritrade.com/trading/options-futures-15073>

firm likewise points out that “SPX Options are priced to the future value of the index reflecting adjustments for dividends and interest rate, which is how the E-mini futures are priced.”⁴

53. The lockstep movement of the S&P 500 (identified below by its ticker symbol “SPX”) (and hence SPX Options) and E-mini futures can be seen in the table from December 2015 below:



54. E-mini futures share a direct correlation with options on S&P 500 futures, insofar as an E-mini future for a given month (i.e., February 2019) has a notional value which is one-fifth of the S&P 500 future for that same month (\$50 multiplied by the S&P 500 index value vs. \$250 multiplied by the S&P 500 value). Because (1) the underlying instrument of options on S&P 500 futures is the S&P 500 futures contract, (2) the S&P 500 futures contract is directly proportional (at five times the size) to the E-mini futures contract, and (3) the E-mini Futures contract moves in lockstep with the S&P 500 index (and thus SPX Options), it follows that all three move in tandem, and that manipulation in the prices of any one of these three instruments would, necessarily, impact and cause manipulation in the prices of the others. Indeed, if they did

⁴ <https://www.tradingfloor.com/posts/product-focus-what-you-need-to-know-about-sp-options-saxostrats-8753750>

not move in tandem in this fashion, any disparities between them would immediately be removed by market participants engaging in arbitrage.

55. Put another way, SPX options cash-settle to the value of the S&P 500 index. Options on S&P 500 futures settle to futures which in turn cash-settle to the value of the S&P 500 index. While options on S&P 500 futures require an extra step to settlement versus the S&P 500 index, market participants consider SPX options and options on S&P 500 futures to be equivalent instruments. An increase in the price of one will be instantly transmitted to the price of the other.

56. As this Complaint demonstrates below, when John Doe Defendants manipulated and inflated the value of the VIX (via inflating prices for out-of-the-money SPX Options) on February 5, 2018, the interrelated nature of the prices of SPX Options, options on S&P 500 futures, and E-mini futures ensured that the impact of SPX Option manipulation was felt in all three instruments, and damaged individuals who traded in all three.

C. THE VIX, AND THE ROLE OF SPX OPTIONS IN ITS CALCULATION

57. VIX is a benchmark index that measures the 30-day expected volatility of the S&P 500 Index for large cap U.S. stocks, and is colloquially referred to as the “fear index” or the “fear gauge.” Widely reported by the financial media and closely followed by market participants as a leading market indicator, the VIX is higher when the market is expected to be more volatile 30 days in the future, and is lower when the market is expected to be less volatile 30 days in the future.

58. First introduced in 1993, VIX is calculated and published by CBOE every 15 seconds during CBOE’s regular trading hours (8:30 a.m. to 3:15 p.m. Central time) and extended trading hours (2:00 a.m. to 8:15 a.m. Central time), based on the premiums paid for (or the

midpoint of bid-ask prices of) certain “put” and “call” SPX Options during those time periods (i.e., the cost of purchasing the options at particular strike prices).

59. VIX relies upon the premiums paid for SPX Options at various strike prices (or the midpoint of bid-ask quotes in those options) as a stand-in to measure expected near-term volatility because one component in the price of SPX Options is an estimate of how volatile the S&P 500 will be between now and the option’s expiration date, allowing the volatility that the market expects in the S&P 500 over the next 30 days to be estimated from SPX Option premiums (or bid-ask quote midpoints) settling around 30 days from the present.

60. The CBOE explains the relationship between SPX Options and the VIX on its website:

The VIX Index is an up-to-the-minute market estimate of implied (expected) volatility that is calculated by using the midpoint of real-time S&P 500® Index (SPX) option bid/ask quotes. More specifically, the VIX Index is intended to provide an instantaneous measure of how much the market thinks the S&P 500 Index will fluctuate in the 30 days from the time of each tick of the VIX Index.

Cboe Options Exchange® (Cboe®) calculates the VIX Index using standard SPX options and weekly SPX options that are listed for trading on Cboe. Standard SPX options expire on the third Friday of each month and weekly SPX options expire on all other Fridays. Only SPX options with Friday expirations are used to calculate the VIX Index. Only SPX options with more than 23 days and less than 37 days to the Friday SPX expiration are used to calculate the VIX Index. These SPX options are then weighted to yield a constant, 30-day measure of the expected volatility of the S&P 500 Index.

61. If expected near-term future volatility (and thus swings in the market price of the S&P 500) is high, SPX Options (which serve as a means to hedge against large swings in the price of the S&P 500) are more valuable and thus have higher premiums and are more expensive. If expected near-term future volatility is low, the benefits of holding SPX Options to hedge against swings in the S&P 500 is lower, and therefore the premiums paid for SPX Options are also cheaper.

62. Put another way, the VIX is a simple measurement of the stock market's (S&P 500) expected annualized movement over the next 30 days. The VIX is quoted in percentage points. As an example: a "VIX at 20" represents an annual expected change or variance in either direction of 20% of the S&P 500 Index at a 68% confidence level. This is also known as a one standard deviation move. As the confidence level increases, the variance increases proportionally. A two standard deviation move achieves a 95% confidence factor, while a three standard deviation move goes to 99.7%.

63. The chart below represents the market's anticipation of how much the S&P 500 could move over a year with a VIX at 20, using 2500 as the current S&P 500 Index level. With a 68% confidence factor, the S&P 500 Index will range between 2250 and 2750. With a 95% confidence factor, the S&P 500 Index will range between 2000 and 3000. Finally, with a 99.7% confidence factor, the S&P 500 index will range between 1750 and 3250.

	VIX = 20 Current S&P 500 = 2500	
Confidence Factor	S&P Low	S&P High
68 Percent	2250	2750
95 Percent	2000	3000
99.7 Percent	1750	3250

64. To come up with a 30-day measure of expected volatility in the S&P 500, the data used for VIX calculation are the prices of near- and next-term put and call SPX Options with more than 23 days and less than 37 days to expiration. These include SPX options with "standard" third Friday expiration dates and "weekly" SPX options that expire every Friday, except the third Friday of each month. The relevant prices are the average of the bid and ask quotes of these options.

65. Once each week, the SPX options used to calculate VIX “roll” to new contract maturities in order to maintain a 30-day expectation of volatility measured by the index. For example, on the second Tuesday in October, the VIX Index would be calculated using SPX options expiring 24 days later (*i.e.*, “near-term”) and 31 days later (*i.e.*, “next-term”). On the following day, the SPX options that expire in 30 calendar days would become the “near-term” options and SPX options that expire in 37 calendar days would become the “next-term” options, thereby maintaining the “more than 23 days and less than 37 days to expiration” window.

66. Below is CBOE’s standard formula used to calculate the VIX. The values used in the calculation include: (1) forward SPX level “F”; (2) time to expiration “T”; (3) risk-free interest rate “R”; (4) “ K_i ” representing the strike price for any given out-of-the-money SPX option “ i ”; (5) the price of that selected option “ $Q(K_i)$ ”; and (6) the average distance between strike prices immediately above and below the forward index level, or “ ΔK_i .”

$$VIX = 100 * \sqrt{\frac{2}{T} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T} \left[\frac{F}{K_0} - 1 \right]^2}$$

67. Only “out-of-the-money” options that have non-zero bids are included in the VIX calculation. A call option is out-of-the-money when the strike price of the option is higher than the market price of the underlying asset. A put option is out-of-the-money when the strike price of the option is lower than the market price of the underlying asset.

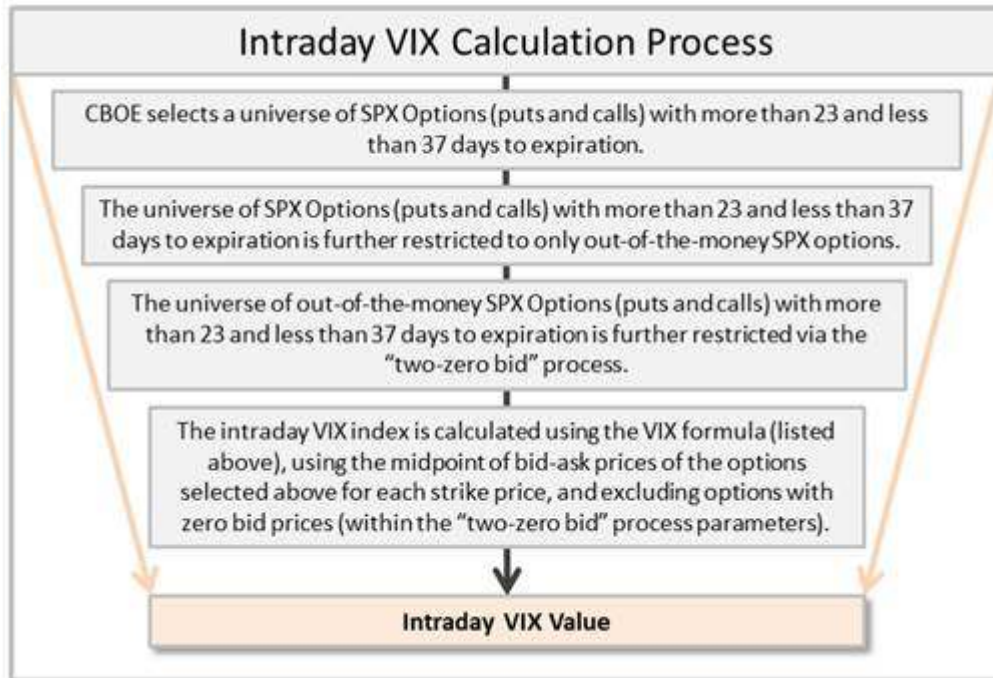
68. The selection of strikes goes from the at-the-money strike up (for calls) and down (for puts), until two consecutive strikes with a zero-bid price are found in each direction. No other options beyond such two consecutive zero-bid strikes are included. Examples below

illustrate the selection process and how whether a given strike price is included in the calculation of the VIX process is dependent on whether participants have chosen to bid on puts or calls at those strike prices:

Put Strike	Bid	Ask	Include?
1345	0	0.15	<i>Not considered following two zero bids</i>
1350	0.05	0.15	
1355	0.05	0.35	
1360	0	0.35	No
1365	0	0.35	No
1370	0.05	0.35	Yes
1375	0.1	0.15	Yes
1380	0.1	0.2	Yes
.	.	.	.

Call Strike	Bid	Ask	Include?
.	.	.	.
2095	0.05	0.35	Yes
2100	0.05	0.15	Yes
2120	0	0.15	No
2125	0.05	0.15	Yes
2150	0	0.1	No
2175	0	0.05	No
2200	0	0.05	<i>Not considered following two zero bids</i>
2225	0.05	0.1	
2250	0	0.05	
.	.	.	.

69. This entire VIX calculation process is summarized in the following diagram:



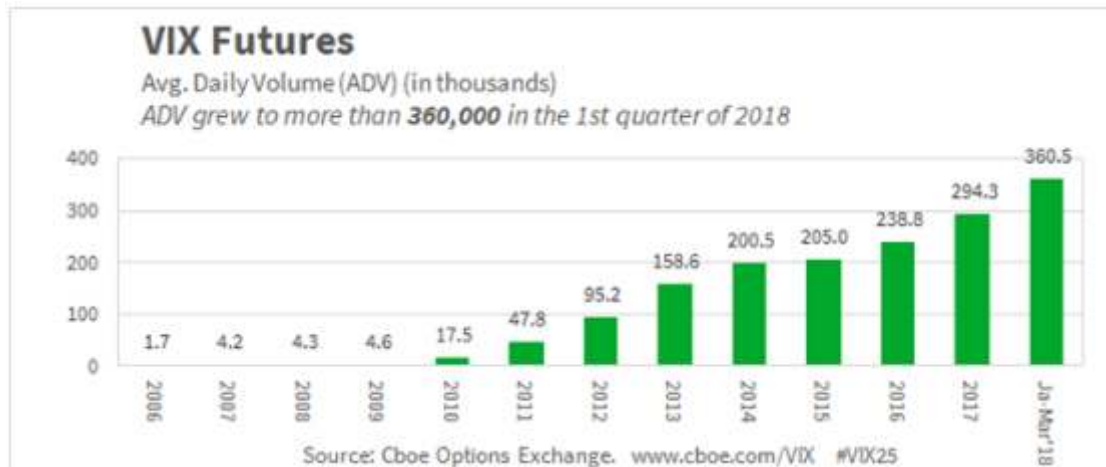
70. Because investors cannot trade the VIX directly (it is merely an index like the S&P 500 Index, expressed as a number that cannot be “delivered”), CBOE created VIX-related products to monetize the VIX and allow investors to utilize it as a directly traded benchmark.

71. CBOE launched VIX Futures on March 26, 2004 for exclusive trading on the Chicago Futures Exchange (CFE),⁵ and CBOE launched VIX Options on February 24, 2006 for exclusive trading on the Chicago Board Options Exchange.⁶

72. Trading in VIX Futures and VIX Options has grown enormously since CBOE introduced them. As shown in the chart below, the average daily trading volume of VIX Futures rose to 360,000 contracts in the first quarter of 2018.

⁵ See <https://www.cboe.com/aboutcboe/cboe-cbsx-amp-cfe-press-releases?DIR=ACNews&FILE> (last accessed July 17, 2018).

⁶ See <https://www.cboe.com/aboutcboe/cboe-cbsx-amp-cfe-press-releases?DIR=ACNews&FILE> (last accessed July 17, 2018).



73. As shown in the chart below, the average daily trading volume of VIX Options rose to 1.06 million contracts in the first quarter of 2018.



74. In addition to high trading volumes, there are a very large number of open VIX Futures and VIX Options contracts at any time. For example, on February 1, 2018, there were 636,649 outstanding VIX Futures contracts (notional value of more than \$636 million) and 13,223,224 outstanding VIX Options contracts (notional value of more than \$1.32 billion).⁷

⁷ CBOE Daily Market Statistics, <http://www.cboe.com/data/current-market-statistics/daily-market-statistics-2-cboe#VIX>; CBOE Futures Daily Statistics, https://markets.cboe.com/us/futures/market_statistics/daily/?dt=2018-02-01 (last accessed July 19, 2018).

75. VIX Futures and VIX Options trading exploded on the heels of the Financial Crisis of 2007-2008. With the meltdown in the financial markets, investors looked to products that “truly” moved inversely with the markets during a highly volatile period. For example, between January 1, 2004 and December 31, 2006, the VIX never rose above 24 at any single point. However, while U.S. financial markets were generally melting down during the Financial Crisis, the VIX was growing — between January 1, 2007 and December 31, 2009, the VIX closed above 24 on 376 out of 756 trading days (49.7% of trading days), closing at an all-time high of 80.86 on November 20, 2008.⁸

76. In response to demand for VIX products for retail investors, CBOE authorized the creation of VIX exchange-traded products, or VIX ETPs. Exchange-traded products are a type of security that is derivatively priced and trades intra-day on a national securities exchange. ETPs are “hybrid instruments” under the Commodity Exchange Act (7 U.S.C. §1(29)), priced so their value is derived from other investment instruments, such as a commodity, a currency, a share price or an interest rate.

77. Generally, ETPs are benchmarked to stocks, commodities, or indices. They can also be actively managed funds. ETPs include exchange-traded funds, exchange-traded vehicles, exchange-traded notes and certificates. ETPs are traded on exchanges (like the New York Stock Exchange), and thus can be bought and sold by individual investors as easily as any share of common stock.

78. Barclays plc created the first VIX ETP: an instrument that tracks VIX futures, but which trades on an exchange like any other corporate stock. The Barclays iPath S&P 500 VIX

⁸ See “VIX data for 2004 to present (Updated Daily),” VIX Options and Futures Historical Data, CBOE, <http://www.cboe.com/products/vix-index-volatility/vix-options-and-futures/vix-index/vix-historical-data> (last accessed July 17, 2018).

Short-Term Futures ETN launched in 2009.⁹ That instrument, along with other VIX ETPs that quickly followed, attracted a massive influx of investors thanks to being readily available for trading on public exchanges.

79. There are now a number of VIX ETPs offering exposure to the VIX. Additionally, there are a number of “inverse” VIX ETPs that are intended to generate returns inverse to VIX such that if VIX fell the inverse VIX ETPs would gain value. The largest of these was Credit Suisse’s VelocityShares Daily Inverse VIX Short-Term ETN, which went by the ticker symbol XIV. In the wake of the February 5, 2018 spike in VIX, Credit Suisse triggered a provision in XIV’s offering documents that allowed it to liquidate XIV after it had lost more than 90% of its value.

80. On information and belief, John Doe Defendants were sizeable investors in VIX Options, VIX Futures, VIX ETPs, and/or inverse VIX ETPs, and specifically had taken positions in all or some of them such that upward movement of the VIX would result in large profits (i.e., long positions in VIX Options, VIX Futures, and/or VIX ETPs, or short positions in inverse VIX ETPs). This created an incentive to manipulate the VIX upwards; an opportunity that John Doe Defendants took advantage of on February 5, 2018.

D. THE VIX WAS SUSCEPTIBLE TO MANIPULATION, AND RESEARCH SUGGESTS IT WAS MANIPULATED PRIOR TO FEBRUARY 5, 2018

81. The method by which VIX is calculated is vulnerable to manipulation, particularly upward manipulation. Simply put, if a VIX trader is long VIX futures (or VIX Options, or VIX ETPs), he can push the VIX up by buying out-of-the-money SPX Options at inflated premiums or bidding up bid-ask quotes for those out-of-the-money SPX Options, creating an artificial appearance that market participants believe expected volatility (as measured

⁹ See Product Summary, iPath® S&P 500® VIX Short-Term Futures™ ETN, <http://www.ipathetn.com/US/16/en/details.app?instrumentId=259118> (last accessed July 17, 2018).

by out-of-the-money SPX Options premiums or the mid-point of the bid-ask quotes for such out-of-the-money SPX Options) is higher than it is in reality.

82. Essentially, parties wishing to manipulate the VIX higher use strategic and artificial bidding on the SPX Options market to increase the premiums of out-of-the-money SPX Options used in calculating the VIX, thus increasing the VIX itself and resulting in corresponding increases to their VIX-linked instruments (VIX Options, VIX Futures, and VIX ETPs).

83. In recent years, market participants, journalists, and academics have offered evidence suggesting that the VIX is indeed being manipulated by certain players to the detriment of others.

1. The Griffin Paper finds manipulation in VIX monthly settlements

84. Significantly, in May 2017, Professor John Griffin of the McCombs School of Business at The University of Texas Austin, along with then-PhD candidate at the McCombs Business School, Amin Shams, published a research paper (the “Griffin Paper”) titled *Manipulation in the VIX?*

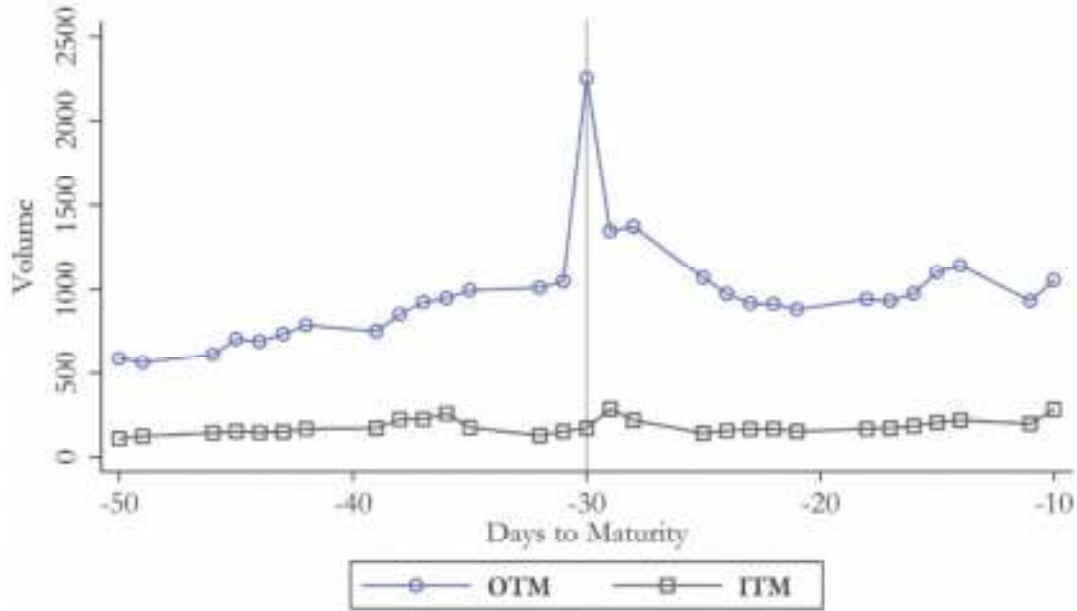
85. The Griffin Paper made several key findings: (1) at the exact time of the monthly VIX settlement (i.e. the day that monthly VIX Options and VIX Futures are settled on the CBOE via a pre-opening auction process known as the Special Opening Quotation, or “SOQ”), highly statistically significant trading volume spikes occur in underlying SPX options; (2) the spikes occur only in out-of-the-money SPX options — those utilized for the VIX settlement calculation during the SOQ — and more so for those with greater influence on the calculation; (3) there is no spike in volume for the similar S&P 100 Index or in S&P 500 Exchange Traded Fund options, which are not connected to the VIX; and (4) traders manipulated the settlement by optimally

spreading their trades across the SPX option strikes and increasing the number of trades in deep out-of-the-money put options consistent with the VIX formula, despite such options rarely being traded otherwise.

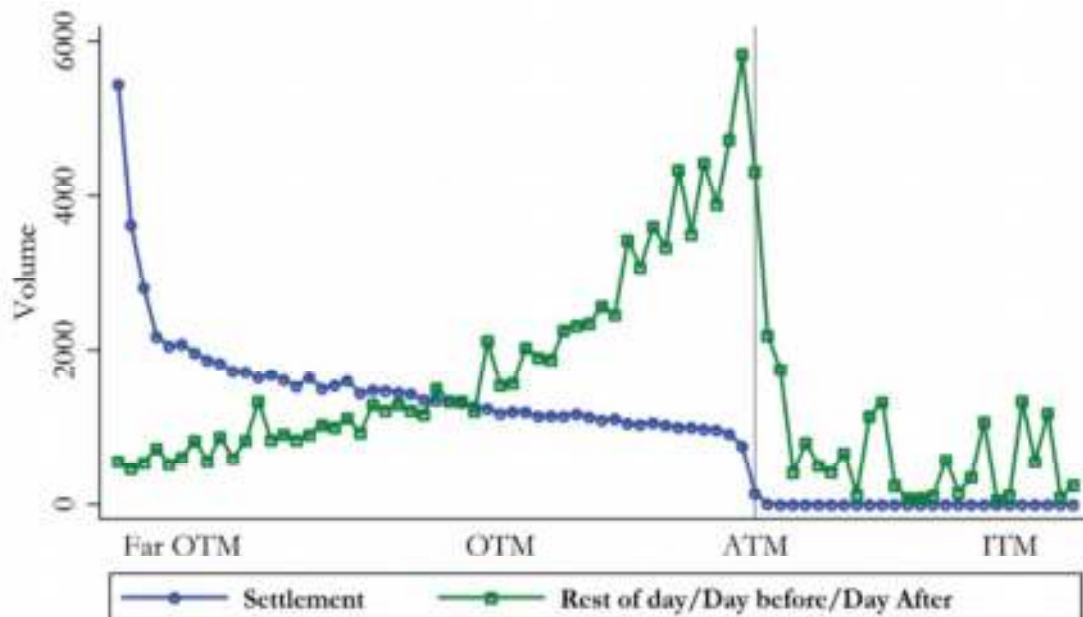
86. According to the Griffin Paper, the steps required for a trader to manipulate the VIX settlement during the SOQ are as follows: (1) open long positions in the VIX derivatives prior to settlement; (2) submit aggressive buy orders in the SPX options during the settlement auction, thereby causing the auction-clearing prices of SPX options, and by extension, the VIX settlement price to rise; and (3) obtain the higher price desired for the VIX Futures or Options when they settle. These same steps, if employed during intraday trading, would likewise manipulate the intraday VIX upwards.

87. Analyzing trade data from January 2008 through April 2015, the Griffin Paper's findings suggest that traders deliberately engaged in trading activity designed to manipulate the SOQ VIX settlement price up. For example, in months where the trading pushes the VIX settlement price up, the prevailing price of the VIX-influencing options will jump during the SOQ auction, peak at around 8:15 a.m. (*i.e.*, the deadline for VIX-related bids to be accepted for the SOQ prior to January 2017), and then drop seconds after the auction ends, when SPX Options revert to normal trading patterns.

88. The Griffin Paper also found that that "at the exact time of monthly VIX settlement [for VIX Futures and VIX Options], highly statistically and economically significant trading volume spikes occur in the underlying SPX options" and that the "spike occurs only in the OTM [or out-of-the-money] SPX options that are included in the VIX [S]ettlement [Price] calculation and not in the excluded in-the-money (ITM) SPX options":



89. Tellingly, the spike in out-of-the-money SPX Options during the settlement window occurs principally in (otherwise) rarely traded SPX Options that are priced the furthest out-of-the-money, and have a significant manipulative impact on the VIX Settlement Price:



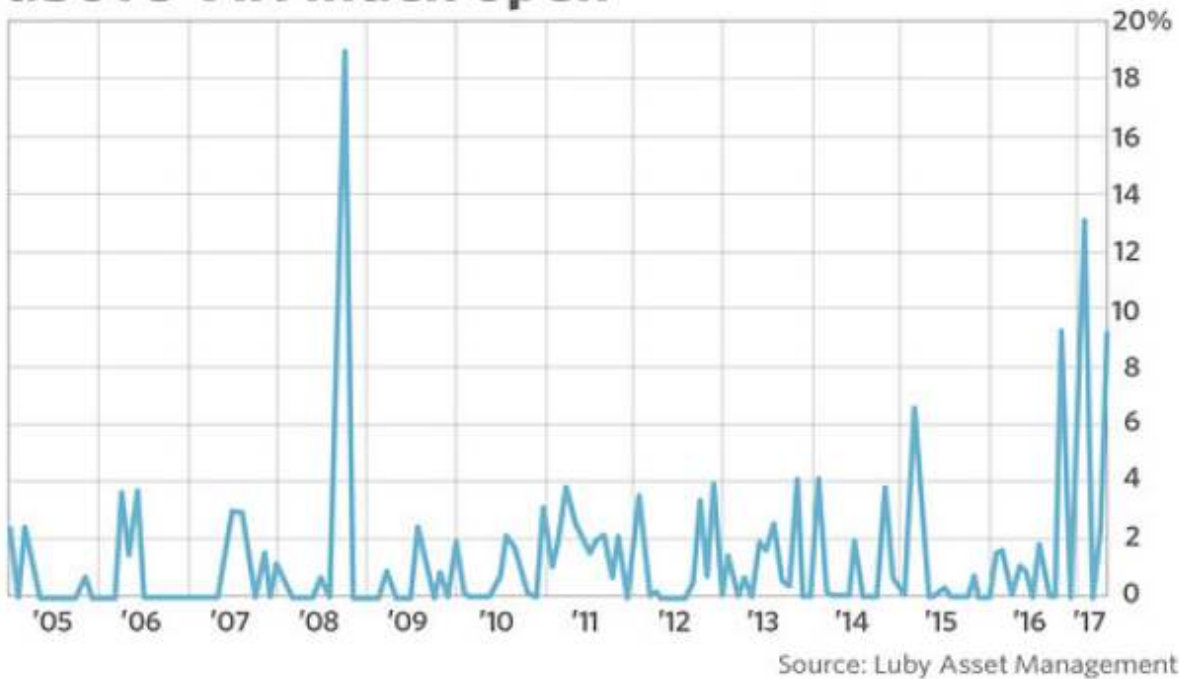
2. Additional Analysis Supporting the Griffin Paper's Manipulation Theory

90. The Griffin Paper is further supported in its findings of manipulation by looking at fluctuations between (a) the VIX benchmark at the day's prior close, (b) the SOQ settlement value, and (c) the VIX benchmark at the open of the day immediately following the SOQ calculation window. In a market absent manipulation, you would expect these values to be roughly in line with each other in some fashion. Instead, a review of recent VIX data and SOQ prices shows evidence that the SOQ settlement is being manipulated higher and out of line with both the prior day's close and the subsequent open:

Settlement Date	VIX Close (Day Before Settlement)	VIX Settlement Value	VIX Open (Day Of Settlement)	Change From Close To Settlement	Change From Settlement To Open
02/15/2017	10.74	12.26	10.84	+14.15%	-11.58%
08/16/2017	12.04	12.95	11.59	+7.56%	-10.50%
01/17/2018	11.66	12.61	11.35	+8.15%	-9.99%
11/15/2017	11.59	13.79	12.52	+18.98%	-9.21%
11/16/2016	13.37	14.76	13.51	+10.40%	-8.47%
05/17/2017	10.65	12.98	11.89	+21.88%	-8.40%
01/18/2017	11.87	12.52	11.79	+5.48%	-5.83%

91. This upward manipulation increased sharply in 2017 (just prior to February 5, 2018), as shown in the chart below:

VIX futures special opening quotations above VIX index open



92. In 12 of the 111 (10.8%) monthly settlements that have occurred since January 2009, the settlement value for VIX has been higher than the highest VIX value at any point during the day preceding settlement and the day of settlement. For example, on October 17, 2017, the highest intraday VIX value was 10.46, and on October 18, 2017 (the settlement date), the highest intraday VIX value was 10.41. And yet the settlement value for VIX on October 18, 2017 was 10.53 – higher than the highest intraday value for VIX on either of those days. Manipulation is the most plausible explanation for such an anomaly.

93. The chart below shows the 12 instances in which this has occurred:

Settlement Date	VIX Range (Day Before Settlement)	VIX Range (Day Of Settlement)	VIX Settlement Value
10/18/2017	9.78 – 10.46	9.87 – 10.41	10.53
08/16/2017	11.45 – 12.37	11.25 – 12.54	12.95
02/15/2017	10.73 – 11.34	10.80 – 12.01	12.26
11/16/2016	13.30 – 14.65	13.51 – 14.49	14.76
11/20/2013	12.88 – 13.68	12.97 – 13.94	14.12
09/18/2013	14.28 – 14.61	13.23 – 14.68	14.77
06/19/2013	16.46 – 16.95	15.36 – 17.18	17.22
10/17/2012	14.50 – 15.23	14.90 – 15.63	15.96
01/18/2012	20.69 – 22.25	20.78 – 23.44	23.64
10/20/2010	19.33 – 21.35	19.67 – 21.20	21.41
09/15/2010	20.85 – 21.97	22.10 – 22.80	22.97
08/19/2009	26.08 – 27.89	26.14 – 28.14	28.76

94. Astonishingly, there were three instances for which the settlement value of VIX was higher than the entire intraday trading range of VIX for at least the entire week before settlement and at least the entire week after settlement. That is, VIX reached its highest point for more than a two-week span precisely at settlement:

- a. **August 19, 2009:** The settlement value of VIX was 28.76. From August 10 to August 27, the intraday VIX ranged from 23.68 to 28.39.
- b. **January 18, 2012:** The settlement value of VIX was 23.64. From January 6 to January 26, the intraday VIX ranged from 16.8 to 23.44.
- c. **November 20, 2013:** The settlement value of VIX was 14.12. From November 11 to November 29, the intraday VIX ranged from 11.99 to 13.94.

95. As further evidence that VIX has been manipulated upward, VIX settlement values were compared to overnight movements in the S&P 500 Index. Because VIX measures “fear,” there is a well-established statistical correlation between the overnight movements in the S&P 500 Index and the opening value of VIX the next day. If the S&P 500 Index goes down, VIX goes up; if the S&P 500 Index stays the same or increases, VIX stays the same or goes

down. That relationship, however, often fails to hold true on settlement days, providing another indication that VIX has been manipulated.

96. On at least the following days, the S&P 500 Index opened higher on the settlement day than the close on the prior day, but VIX still increased:

- a. **December 19, 2012:** VIX closed at 15.55 the day before. The S&P 500 Index opened higher on December 20, 2012. The settlement value was 16.69 (a 7.33% increase).
- b. **December 17, 2014:** VIX closed at 23.10 the day before. The S&P 500 Index opened higher on December 18, 2014. The settlement value was 24.09 (a 4.28% increase).
- c. **February 15, 2017:** VIX closed at 11.18 the day before. The S&P 500 Index opened higher on February 16, 2017. The settlement value was 12.26 (a 9.66% increase).

97. Furthermore, while the Griffin Paper focuses on the separate, monthly SOQ settlement process for VIX Futures and VIX Options, intraday manipulation of the VIX is possible in the same fashion as both use the same formula to calculate VIX – by bidding up premiums (or the mid-point of bid-ask spreads) for out-of-the-money SPX Options, one could increase the VIX intraday/at close of day in the same fashion as during the SOQ settlement window.

98. Indeed, manipulation of the VIX during intraday trading may have advantages to the manipulator compared to manipulation during the SOQ settlement. The SOQ settlement level is based on clearing prices for actual trades that are executed in SPX Options during the SOQ auction window, meaning would-be manipulators have to spend funds on premiums and/or execute trades that would put themselves at risk (should the SPX Options they sold end up in-the-money).

99. By contrast, the intraday VIX calculation (calculated every 15 seconds) is dependent on the midpoints of quoted bid-ask spreads to determine the price of SPX Options across a wide number of strike prices. A would-be manipulator of the intraday VIX calculation, therefore, could engage in manipulation simply by bidding up (but not executing) the bid-ask spreads of out-of-the-money SPX Options without having to commit actual capital towards executed trades and paying premiums. Intraday VIX manipulation also allows manners of manipulation (such as spoofing, i.e., submitting false bid or ask quotes and then pulling them back before they could be acted upon) to increase the VIX that are not available in the auction-style SOQ (which requires bids to be locked in place as part of its auction process).

3. Market participants suggest the VIX is susceptible to manipulation

100. Other market participants have reached similar conclusions as the Griffin Paper, and opined that the VIX is vulnerable to manipulation. Timothy Klassen, a member of the Goldman Sachs team that assisted CBOE in the development of the VIX, said that “trying to manipulate the VIX is not conceptually different from trying to manipulate any other index” that is dependent on underlying financial contracts.¹⁰

101. Matt Levine, a columnist for Bloomberg and former investment banker at Goldman Sachs, echoed this by stating:

[I]f you are a trader who owns a lot of the market in VIX futures, you could push around a large dollar value of futures by trading a small dollar value in [SPX] options. This is particularly true because the S&P option volume is divided among many strikes, and the illiquid deep out-of-the-money S&P 500 options have a big influence on the VIX: You can move the price of those options a lot with relatively small trades, and those price changes have a disproportionate effect on the VIX . . . *if you are going to*

¹⁰ See Elliot Blair Smith, “How S&P 500 options may be used to manipulate VIX ‘fear gauge,’” MARKETWATCH (June 19, 2017), <https://www.marketwatch.com/story/how-sp-500-options-may-be-used-to-manipulate-vix-fear-gauge-2017-06-19> (last accessed July 17, 2018).

*manipulate a tradable market . . . then VIX looks pretty tempting.”*¹¹ (Emphasis added.)

102. In February 2018, former SEC Chairman Harvey Pitt agreed with the premise that the VIX was susceptible to manipulation, commenting in an interview that “it’s quite clear that [VIX] options can be manipulated. And when there were complaints about possible manipulation, CBOE, as the marketplace, should have sprung into action.”¹²

103. Likewise, on February 14, 2018, former CFTC Commissioner Bart Chilton stated that the allegation that the VIX could be manipulated “rings true to me” and added that “there’s certainly enough smoke” to suggest that the VIX was indeed being manipulated.¹³

4. Enforcement actions show that the VIX has been manipulated in precisely this way.

104. Enforcement actions taken in the past by CBOE itself have confirmed that the VIX can be manipulated via artificially inflating the prices of out-of-the-money SPX Options.

105. For example, Equitec Proprietary Markets LLC, a Chicago-based trading firm and CBOE-designated market maker, was found by the CBOE’s Business Conduct Committee in April 2017 to have submitted manipulative orders in the constituent SPX options used in the VIX settlement calculation. Equitec submitted buy-side SPX orders on constituent options after the applicable cutoff time of 8:15 a.m. CST, which improperly modified a previously submitted

¹¹ Matt Levine, *VIX Trading, Hoaxes and Blockchain* (May 24, 2017), <https://www.bloomberg.com/view/articles/2017-05-24/vix-trading-hoaxes-and-blockchain> (last accessed July 17, 2018).

¹² See Mark DeCambre, “Ex-SEC chairman says ‘it’s quite clear’ Wall Street’s ‘fear gauge’ can be manipulated,” MARKETWATCH (Feb. 16, 2018), <https://www.marketwatch.com/story/ex-sec-chairman-says-its-quite-clear-wall-streets-fear-gauge-can-be-manipulated-2018-02-16> (last accessed July 17, 2018).

¹³ CNBC, *Former CFTC Commissioner: Whistleblower Allegation About Volatility Index Manipulation ‘Rings true’* (Feb. 14, 2018), <https://www.cnbc.com/2018/02/14/ex-cftc-head-bart-chilton-on-whistleblower-vix-manipulation-allegation-html>.

strategy order on the same options, which was then used in the calculation of the October 2013 VIX settlement. CBOE censured Equitec and fined it \$50,000 for this alleged manipulation.

106. Similarly, on June 28, 2016, CBOE fined Morgan Stanley & Co. \$400,000 and disgorged another \$152,664 for violations of trading rules due to manipulating VXEM, a volatility futures contract for emerging markets similar to the VIX. *See In re Morgan Stanley & Co.*, CFE No. 15-0003 (June 28, 2016). CBOE found that, on November 21, 2012 – the settlement day for VXEM – Morgan Stanley placed orders to sell approximately 45,000 options contracts. This caused “approximately half of the strike prices used to calculate VXEM settlement” to “[open] at prices significantly lower than where they had been on the previous day, and where they closed that same day. The orders and trades caused the CFE’s VXEM to settle approximately 17.75% lower than the previous day’s settlement price.” *Id.* ¶3.

107. On December 15, 2017, CBOE fined DRW Securities, LLC \$1,250,000 and disgorged another \$257,056 for violations of trading rules for manipulating VIX. CBOE found that, on nine trade dates between February 2014 and March 2015, DRW Securities, LLC submitted “safety bids” to ensure consecutive SPX Options did not have zero bids thus “ensuring that certain option series were included in the final settlement calculations of the SOQ. This conduct impacted the final settlement calculations.”

108. In both the Morgan Stanley and DRW Securities instances above, the methods of manipulation that resulted in the fines were *the same methods* the John Doe Defendants used in respect of the VIX.

109. Other trading firms have also been fined for various practices related to VIX manipulation. *See In re Ronin Capital, LLC*, File No. 15-0036 (Aug. 10, 2015) (submitting impermissible “strategy orders” during the settlement auction on February 19, 2014); *In re*

Wolverine Execution Servs., LLC, File No. 15-0100 (Dec. 29, 2015) (same for settlement auction on August 20, 2014); *In re Morgan Stanley & Co.*, File No. 12-0029 (Sept. 24, 2012) (same for settlement auction on July 20, 2011 and September 21, 2011); *In re Wolverine Execution Servs., LLC*, File No. 14-0161 (Feb. 12, 2015) (same for settlement auction on December 18, 2013).

110. The CBOE is not the only entity to have launched investigations into manipulation of the VIX. On February 12, 2018, an anonymous whistleblower who “has held senior positions at some of the largest investment firms in the world,” reported to the Securities and Exchange Commission and the Commodity Futures Trading Commission widespread manipulation of VIX. The whistleblower asserted that a “pervasive flaw” permits “trading firms with sophisticated algorithms to move the VIX up or down by simply posting quotes on [SPX Options] and without needing to physically engage in any trading or deploying any capital.” The whistleblower identified large institutional traders in SPX Options as the entities best positioned to avail themselves of these manipulative trading practices -- because they have the resources necessary to engage in the sophisticated manipulation easily, and their manipulative effect can be magnified when the price for a given SPX Option series in the VIX calculation is not based on an actual trade, but rather the midpoint of a bid-ask spread, allowing the manipulator to change the SPX Option price (and impact the VIX) cost-free since providing a bid-ask quote without actually executing a trade costs nothing.

111. The whistleblower letter, along with the Griffin Paper, has spawned multiple investigations and litigation. Some of these investigations and litigation encompass not only specific ETPs or ETPs generally, but also broader inquiries into widespread manipulation of the VIX itself as alleged herein.

112. On February 13, 2018, both the *Wall Street Journal* and the *Financial Times* reported that the Financial Industry Regulatory Authority (FINRA), was examining whether prices linked to the VIX had been manipulated.

113. On February 23, 2018, *Bloomberg* reported that both the Securities and Exchange Commission and the Commodities Futures Trading Commission “have been conducting a broad review of trading since February 5, 2018 when volatility spiked and investors lost billions of dollars.” The *Bloomberg* article also notes that because of the substantial investor losses arising from recent market events, “allegations of market manipulation are getting more attention and government watchdogs face questions about why small-time investors were permitted to buy such products in the first place.”

114. All of these factors identified above – the structure of the VIX calculation, the Griffin Paper, evidence of VIX Futures and Options settlements being manipulated outside of intraday VIX levels, comments by market analysts, and CBOE/governmental enforcement actions and investigations – show not only that the VIX can be manipulated by artificially inflated premiums and bid-ask spreads on SPX options, but that this manipulation had been done on numerous occasions successfully (or successfully until discovered as part of a CBOE enforcement action) prior to February 5, 2018.

115. Upon information and belief, John Doe Defendants knew the VIX was susceptible to manipulation, and successfully manipulated the VIX in this fashion on February 5, 2018.

E. BACKGROUND ON LJM

116. Prior to and heading into trading on February 5, 2018, LJM Partners, Ltd. was a Commodity Trading Advisor and Commodity Pool Operator that managed a number of commodity pools and individual accounts, on behalf of investors.

117. LJM's trading strategy involved trading in derivatives on the CME. Specifically, LJM traded in options on S&P 500 futures. LJM purchased and sold both calls (options to buy S&P 500 futures at a specified price) and puts (options to sell S&P 500 futures at a specified price).

118. LJM's strategy was to manage the option positions that it sold such that, at any given time, they were "out-of-the-money" – that is, if the current market price of the underlying S&P 500 future remained out-of-the-money as of the option expiry date, the option would expire without being exercised by the purchaser, and/or without payment being required by LJM on the option contract. LJM's profit would come from the premium it collected in selling that option.

119. LJM's philosophy was thus focused on the so-called "volatility premium," or the "spread between implied volatility (investors' forecast of market volatility reflected in options pricing) and realized (actual) volatility." The buyer of an option – either a put or call – pays a premium because the buyer is shifting the risk of significant market moves (implied volatility) to the option seller. If the market swings far enough in that direction to reach the strike price (actual volatility), only the seller of the option will be exposed to losses. But if the market never swings far enough to reach the strike price (actual volatility is less than implied volatility), the option is worthless and the seller (LJM) keeps the premium, making the transaction profitable to the option seller.

120. This strategy was premised on the idea that options buyers overestimated the probability of high volatility events in the market, and therefore implied volatility would outpace actual volatility, allowing LJM to collect premiums on options it sold that never came into the money because volatility did not rise as much as investors believed it would. This relationship

between implied volatility and realized volatility has generally been historically robust and has been the subject of extensive academic research.

121. As LJM described its investment approach, it “utilizes S&P 500 options on futures to initiate market neutral positions by simultaneously selling deep-out-of-the-money call and put options, followed by certain adjustments based on movement of the underlying S&P 500 futures contract” with “profits...derived when the prices of options that have been sold decline, such that the options can be purchase for amounts less than the prices at which such options were sold” or “when options expire worthless, providing full profit on the option premium sold (after commission or other fees).” To execute this strategy, LJM sold puts and calls on S&P 500 futures on the CME with strike prices above or below the trading price, collecting premiums for options that remained out-of-the-money because the option buyer had overestimated market volatility, or when they bought back those options for less than the premium they sold them for (after commissions/fees).

122. On a typical day, this strategy meant that LJM traded relatively infrequently, executing less than 25 trades a day. On atypical days with more unfavorable market conditions, LJM might execute as many as 55 trades.

123. This approach was historically very successful for LJM, and profitable for its investors, even in years where the broader markets suffered huge losses during the Financial Crisis, as seen in this table aggregating annual results for LJM’s Moderately Aggressive and Aggressive approaches:

Aggregate Annual Performance of LJM's Moderately Aggressive/Aggressive Approaches

Year	Aggressive Approach Annual Percentage Return	Moderately Aggressive Approach Annual Percentage Return
2004	53.76%	38.22%
2005	42.21%	32.08%
2006	37.71%	31.35%
2007	21.25%	26.33%
2008	-48.05%	-18.69%
2009	50.01%	29.18%
2010	38.16%	22.78%
2011	-5.10%	2.09%
2012	46.48%	34.41%
2013	-3.80%	-4.98%
2014	2.35%	3.26%
2015	26.99%	20.70%
2016	25.40%	19.01%
2017	17.69%	17.58%

124. As a result of this successful trading strategy, LJM had grown to manage approximately \$516.9 million in net assets as the markets opened on February 5, 2018. All of LJM's positions at the beginning of February 5, 2018 were in options on S&P 500 futures traded on the CME. Entering February 5, 2018, LJM held 45,259 net short put positions.

F. FEBRUARY 5-6, 2018

125. As markets opened on February 5, 2018, LJM and its personnel were closely monitoring the markets, as the previous week had seen volatility increasing, but with the VIX still at a relatively low level of 17.31. As late as 10:27 a.m., LJM estimated a profit of approximately \$9.3 million for February 5, 2018, based on its positions and then-prevailing S&P 500 and March S&P 500 Futures index levels.¹⁴

126. Shortly thereafter, the S&P 500 Index began to decline, moving adversely to LJM's overall position. In response, and consistent with LJM's established and back-tested risk management practices, LJM began to adjust its portfolio by employing a variety of trades designed to reduce or rebalance the risk of its portfolio, including but not limited to: (a) buying puts that were close to the then-prevailing S&P 500 index price and selling puts that were farther away from the prevailing S&P 500 index price, known as "rolling" your put position; (b) simultaneously buying a put and selling a call, known as a "risk reversal;" and (c) buying calls and/or puts (or calls spreads/put spreads) so as to reduce your portfolio's risk. By approximately 10:30 a.m. on February 5th, as a hedge or protection against further declines, LJM had risk reduced/risk rebalanced 5,644 of its put positions, or 12.5% of its opening positions.

127. By noon on February 5, U.S. stock markets had continued to decline, and the VIX began to move higher in an orderly manner, with the VIX at 12:01 p.m. being computed at 19.58. LJM estimated that its marked-to-market profit and loss for the day had begun to show losses, estimating that its negative open trade/liquidation loss for the day was approximately \$12.8 million from its opening value. LJM continued to engage in risk reduction/risk rebalancing trades, and by 12:00 p.m. had risk reduced/risk rebalanced 9,352 of its put positions, or 20.7% of its opening positions.

¹⁴ All times listed are Central time.

128. At approximately 1:00 p.m., the VIX suddenly began to move more rapidly to the upside, for reasons that cannot be explained by normal market forces. By approximately 1:57 p.m., the VIX had risen to 27.97, an increase of 61.6% from its opening level. By this point, LJM had risk reduced/risk rebalanced 19,093 of its put positions, or 42.2% of its opening positions

129. Indeed, as the table below shows, between 1:00 p.m. ET and 4:00 p.m. ET on February 5, 2018, the correlation between the S&P 500 index and VIX went to essentially zero, meaning the two were completely uncorrelated – a situation that should not occur under normal market conditions since the VIX is meant to measure volatility in the S&P 500 index itself. By comparison, a competing volatility index listed on the NASDAQ, the Nations Large Cap VolDex, or VOLI, maintained its correlation with the S&P 500 index during that same time period. Essentially, in the afternoon of February 5, 2018, the historical correlation between the VIX and S&P 500 ceased to exist – evidence that the VIX itself was being manipulated:

Period	Standard Deviation of 1-Minute Returns			Correlation of 1-Minute Returns to S&P 500 Index		
	VOLI	VIX	S&P 500 Index	VOLI	VIX	S&P 500 Index
January 2 – February 6	0.44%	0.56%	0.05%	-57.17%	-23.55%	-
January 2 – January 31	0.25%	0.25%	0.03%	-48.25%	-36.06%	-
February 5-6	1.27%	1.75%	0.13%	-59.87%	-18.11%	-
February 5, 1:00 pm – 4:00 pm ET	1.31%	2.29%	0.14%	-64.16%	0.94%	-

Data Source: Reuters

130. Because the VIX was calculated using premiums or the midpoint of bid-ask spreads on out-of-the-money SPX Options, an increase in the VIX represented an increase in the price of out-of-the-money SPX options. In turn, because SPX Options are highly correlated with options on S&P 500 futures, the increase to out-of-the-money SPX Options prices meant that prices for the out-of-the-money options on S&P 500 futures that LJM invested in were increasing as well, triggering LJM to engage in additional trades based on its risk reduction/rebalancing practices based on these artificially high prices, and making these risk reduction/risk rebalancing trades more expensive as the VIX climbed.

131. LJM estimated at 1:57 p.m. that it had incurred a loss of approximately \$110.2 million as a result in part of the trades it had been forced to enter into and the higher premiums it was paying in risk reduction/risk rebalancing of its positions. By 2:00 p.m., LJM had risk reduced/risk rebalanced 27,084 of its put positions, or 59.8% of its opening positions, all triggered by the artificial prices in the market and all occurring at higher costs due to the manipulated increases in the VIX and out-of-the-money SPX Options prices.

132. The VIX, however, continued its erratic and unpredictable climb in these last two hours of trading. By 2:00 p.m., the ability to obtain meaningful bids and quotes for options on S&P 500 futures market had completely evaporated. The range between the bid and ask prices for SPX Options and the highly correlated options on S&P 500 futures increased dramatically, increasing the VIX and making participants who were seeking to liquidate or adjust positions in options on S&P 500 futures incapable of doing so without paying excessive premiums or subjecting their trades to drastic, unknown results. The late afternoon skyrocketing of the VIX can be seen in the chart below:



133. By the close of trading on February 5th (and the S&P 500's 4.1% decline), LJM had risk reduced/risk rebalanced 39,778 of its put position, or 87.9% of its opening put positions – a far greater number of trades than LJM had ever engaged in on any other single prior day, including days where the S&P 500 had suffered a similar 4%-5% decline. As a result of these trades – triggered by artificial prices caused by John Doe Defendants' manipulation and occurring at higher prices paid in premiums due to that manipulation – LJM estimated that by 3:09 p.m. on February 5th that it had incurred a marked-to-market loss of approximately \$334.9 million.

134. Instability in the VIX (and corresponding/related higher prices for SPX Options and options on S&P 500 futures) continued in the after-hours trading on the evening of February 5 and early morning of February 6, 2018. This instability and the losses LJM had incurred on February 5 resulted in LJM's clearing firm, Wells Fargo Securities, LLC, delivering LJM a written notice of the termination of LJM's trading account, and ordering LJM to promptly

liquidate its positions held in the Wells Fargo account including using E-mini futures to hedge its positions if necessary.

135. At the insistence of Wells Fargo, prior to the opening of the market, LJM was forced to sell E-mini futures to offset its then current options positions. After the market opened, Wells Fargo forced LJM to sell additional E-mini futures.

136. However, markets for SPX Options – as well as the highly correlated options on S&P 500 futures and E-mini futures – continued to be illiquid, with bid-offer ranges either not being quoted at all, or being quoted with such wide spreads as to make entering any meaningful orders impractical or impossible. As a result, LJM's sale of these E-mini futures was done at extremely adverse prices, resulting in LJM incurring approximately an additional \$35 million in losses.

137. Initial upward price movement in the U.S. stock market on the open of markets on February 6 relieved the immediate risk of further adverse effects of price declines in the S&P 500. However, concerned about volatility and the possibility of adverse price movement in the S&P 500 index, Wells Fargo delivered termination of business letters to LJM stating that LJM must promptly liquidate or transfer all of its open positions to a different clearing firm.

138. By 10:23 a.m. on February 6, 2018, LJM (at the demand of Wells Fargo), had begun to offset or liquidate its put options on S&P 500 futures. Given the chaotic conditions in the market and the losses it had suffered, LJM was forced to close all its remaining positions. The final result for LJM was that by the end of February 6, 2018, LJM and its funds had suffered a total loss of approximately \$446.8 million, or approximately 86.5% of the assets in its management prior to the opening of markets on February 5, 2018.

139. If the VIX, SPX Options, and their correlated options on S&P 500 futures and E-mini futures performed in a manner historically commensurate with a 4.1% decline in the S&P 500 (as discussed further below), LJM's losses would not have been as severe, and would have been palatable and recoverable for its funds and investors. Defendants' manipulation of the VIX via its component SPX Options prices (and the corresponding effect that had on prices of correlated options on S&P 500 futures/E-mini futures), however, forced LJM to book losses on February 5-6, 2018 that were catastrophic.

140. Not everyone was suffering on February 5, 2018, however – entities that were long on volatility (including John Doe Defendants) profited as the VIX skyrocketed. Goldman Sachs boasted that it made \$200 million in profit on February 5, 2018, because it “had positioned itself to benefit if the CBOE Volatility Index...climbed” – an amount that was “on par with what the firm's derivatives unit typically makes in an entire year.”¹⁵

G. LJM'S INVESTIGATION DEMONSTRATES THAT THE VOLATILITY SPIKE OF FEBRUARY 5 WAS THE RESULT OF JOHN DOE DEFENDANTS MANIPULATING THE VIX VIA ARTIFICIALLY RAISING PRICES FOR SPX OPTIONS, THEREBY HARMING LJM WHEN IT ROLLED ITS POSITIONS IN CORRELATED INSTRUMENTS.

141. In the wake of its catastrophic losses, LJM investigated what had occurred on February 5-6, 2018, in an attempt to determine whether its losses were caused in whole or in part by market manipulation.

142. This investigation included reviewing publicly available order activity from the CBOE and CME related to the S&P 500, SPX Options, the VIX, options on S&P 500 futures,

¹⁵ See <https://www.cnbc.com/2018/05/23/goldman-made-a-staggering-200-million-in-one-day-as-markets-plunged.html>. LJM mentions Goldman Sachs solely to show the profitability of being long on volatility on February 5, 2018 and the incentive that may have existed for John Doe Defendants to manipulate the VIX on that date so as to increase their profits; LJM does not know whether Goldman Sachs is a John Doe Defendant, but believes this could be determined via discovery of CBOE trading records.

and E-mini futures. By looking at past historical data on days with similar greater-than-4% declines in the S&P 500 Index, LJM attempted to identify whether the events of February 5, 2018 appeared anomalous and/or suggestive of market manipulation.

1. The increase in the VIX on February 5, 2018 was exponentially disproportionate relative to the decline in the S&P 500.

143. First, LJM looked at how the VIX reacted on February 5, 2018 to a 4.1% decline in the S&P 500 Index – with a 116% increase, the largest single day increase ever recorded – and compared that to how the VIX had performed in prior trading days when the S&P 500 Index had suffered 4% or larger declines.

144. While February 5, 2018's decline in the S&P 500 was the largest one day decline in terms of points (113.19), it was not even among the top 20 largest single-day drops as a percentage of opening value (4.1%):

Largest Single Day Declines in S&P 500 By Points

Rank ↕	Date ↕	Close ↕	Net Change ↕	% Change ↕
1	2018-02-05	2,648.94	-113.19	-4.10
2	2008-09-29	1,106.39	-106.62	-8.79
3	2018-02-08	2,581.00	-100.66	-3.75
4	2008-10-15	907.84	-90.17	-9.04
5	2000-04-14	1,356.56	-83.95	-5.83
6	2008-12-01	816.21	-80.03	-8.93
7	2011-08-08	1,119.46	-79.91	-6.66
8	2015-08-24	1,893.21	-77.68	-3.94
9	2016-06-24	2,037.41	-75.92	-3.59
10	2008-10-09	909.92	-75.02	-7.62
11	1998-08-31	957.28	-69.86	-6.80
12	2018-03-22	2,643.69	-68.24	-2.52
13	2015-08-21	1,970.89	-64.85	-3.19
14	1997-10-27	876.99	-64.65	-6.87
15	2008-10-07	996.23	-60.66	-5.74
16	2011-08-04	1,200.07	-60.27	-4.78
17	2018-02-02	2,762.13	-59.85	-2.12
18	2008-09-15	1,192.70	-59.00	-4.71
19	2018-04-02	2,581.88	-58.99	-2.23
20	2018-04-06	2,604.47	-58.37	-2.19

Largest Single Day Declines in S&P 500 by Percentage of Opening Value

Rank ↕	Date ↕	Close ↕	Net Change ↕	% Change ↕
1	1987-10-19	224.84	-57.86	-20.47
2	1929-10-28	22.74	-3.20	-12.34
3	1929-10-29	20.43	-2.31	-10.16
4	1929-11-06	20.61	-2.27	-9.92
5	1937-10-18	10.76	-1.10	-9.27
6	2008-10-15	907.84	-90.17	-9.04
7	2008-12-01	816.21	-80.03	-8.93
8	1933-07-20	10.57	-1.03	-8.88
9	2008-09-29	1,106.39	-106.62	-8.79
10	1933-07-21	9.65	-0.92	-8.70
11	1987-10-26	227.67	-20.55	-8.28
12	1932-10-05	7.39	-0.66	-8.20
13	1932-08-12	7.00	-0.61	-8.02
14	1932-05-31	4.47	-0.38	-7.84
15	1934-07-26	8.36	-0.71	-7.83
16	2008-10-09	909.92	-75.02	-7.62
17	1940-05-14	10.28	-0.83	-7.47
18	1931-09-24	10.68	-0.84	-7.29
19	1932-09-12	8.15	-0.63	-7.18
20	1933-06-15	9.74	-0.73	-6.97

145. The VIX's 116% increase on February 5, 2018 (from an opening value of 17.31 to a close of 37.32) was the largest ever recorded. Such highly aberrational, non-correlated behavior

between the VIX (highest increase ever) and the S&P 500 (a decline that was not among even the top 20 in history) is highly indicative of non-rational, manipulative trading behavior related to the VIX (and its component SPX Options).

146. One way to analyze the aberrational nature of the VIX's performance on February 5, 2018 is to use standard deviations. A statistical standard deviation is used to estimate the amount of variation or dispersion of a set of data values. Typically, standard deviations are used in financial markets to estimate how far from a central value (in this case, the previous day's VIX settlement) prices or values can be expected to move.

147. The standard deviation is estimated using the following formula:

$$\sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

148. For purposes of the computation, "n" is the data population size and "x" is the mean average. The data population includes the closing value of the VIX for each trading day in the 12 calendar months preceding, and was computed on a rolling 12-month basis from January 1, 2004 through February 5, 2018.

149. Using this approach, LJM determined that the 116% increase in the VIX on February 5, 2018 equates to 13.7 standard deviations from the mean settlement price during the 12 months preceding February 5, 2018 – a deviation that is statistically impossible to explain as a result of rational, fair market activity. Expressed mathematically, the probability of a 13.7 standard deviation result approaches approximately 1×10^{-41} .

150. Indeed, going back to 2004, the VIX never exceeded a 2.91 standard deviation change in one day from its previous 12-month mean settlement price. For instance, there were 4

days in 2008 – amidst the housing market crisis, the bankruptcy of Lehman Brothers, and confusion over the Troubled Asset Recovery Program, – in which the S&P 500 declined by 7.6% or greater. On none of those days did the VIX move as much as it did (in absolute terms, in percentage terms, or in standard deviations from the prior 12 month mean settlement price) as it did on February 5, 2018:

STANDARD DEVIATION MOVEMENT IN VIX SETTLEMENT PRICES DURING SIGNIFICANT DECLINES IN SP 500						
DATE	VIX SETTLEMENT	INCREASE FROM PREVIOUS SETTLEMENT	12 MONTH STANDARD DEVIATION	NUMBER OF STANDARD DEVIATIONS IN SETTLEMENT DAY-OVER-DAY CHANGE		PERCENT DECLINE IN SP 500
9/29/2008	46.72	11.98	4.11	2.91		-8.93
10/9/2008	63.92	6.39	6.83	0.94		-7.62
10/15/2008	69.25	14.12	7.32	1.93		-9.04
12/1/2008	68.51	13.23	15.12	0.88		-8.93
2/5/2018	37.32	20.01	1.46	13.71		-4.1

151. Additionally, since January 1, 2004, there have been 13 different trading days (including February 5, 2018), where the S&P 500 declined by 4-5% in a single day. On none of the other days did the VIX move as much as it did (in absolute terms, in percentage terms, or in standard deviations from the prior 12-month mean settlement price) as it did on February 5, 2018. Indeed, the number of standard deviations in settlement day-over-day change on February 5, 2018 was over four times greater than any other day on which the S&P 500 declined by 4-5%, and in some instances over eighty-five times greater:

STANDARD DEVIATION MOVEMENT IN VIX SETTLEMENT PRICE DURING 4-5% DECLINES IN SP 500

DATE	DAILY SP 500 SETTLEMENT PRICE	CHANGE IN SP 500 SETTLEMENT VERSUS PREVIOUS DAY	VIX SETTLEMENT	INCREASE FROM PREVIOUS SETTLEMENT	12 MONTH STANDARD DEVIATION	NUMBER OF STANDARD DEVIATIONS IN SETTLEMENT DAY-OVER-DAY CHANGE
2/5/2018	2648.94	-4.10%	37.32	20.01	1.46	13.71
8/4/2011	1200.07	-4.78%	31.66	8.28	2.98	2.78
8/18/2011	1140.65	-4.46%	42.67	11.09	4.46	2.49
8/10/2011	1120.76	-4.42%	42.99	7.93	3.75	2.11
9/15/2008	1192.7	-4.71%	31.7	6.04	3.37	1.79
9/17/2008	1156.39	-4.71%	36.22	5.92	3.52	1.68
10/2/2008	1114.28	-4.03%	45.26	5.25	4.72	1.11
11/14/2008	873.29	-4.17%	66.31	6.48	13.64	0.48
2/17/2009	789.17	-4.56%	48.66	5.73	16.57	0.35
3/2/2009	700.82	-4.66%	52.65	6.3	18.6	0.34
4/20/2009	832.39	-4.28%	39.18	5.24	16.26	0.32
2/10/2009	827.16	-4.91%	46.47	2.83	16.56	0.17
3/5/2009	682.55	-4.25%	50.17	2.61	16.64	0.16

152. This analysis suggests that it is virtually impossible that the historic increase in the VIX on February 5, 2018 was the result of legitimate market activity, and instead supports the conclusion that it resulted due to manipulation by John Doe Defendants.

2. The bid-ask spread, average bid-ask size (in contracts) and average trade size of all SPX Options on February 5, 2018 supports the theory that VIX was being manipulated.

153. Second, having established that the movement of the VIX on February 5, 2018 was anomalous and suggestive of manipulation, LJM investigated the SPX Options themselves to determine whether bid-ask quotes on February 5, 2018 were unusual and suggestive of manipulation, compared to past instances when the S&P 500 had declined by around 4%.

154. LJM compared the spread between bids and asks (the midpoint of which would be used in the VIX calculation as the price for that option strike), the average bid and ask size (in contracts), and the average trade size of all SPX Options in 1 minute intervals, as well as all SPX options that were 23-37 days from expiration (i.e., those that would be included in the VIX

calculation). LJM performed this analysis for February 5, 2018 (broken into time periods to demonstrate how the market changed in the late afternoon run-up of the VIX), as well as August 4, August 10, and August 18, 2011 (three days in which the S&P 500 had similarly declined by 4-5%).

SPX Spread Between Bid and Ask, Number of contracts in Bid and Ask, and Trade Size

(computed in 1 minute intervals)

August 4. 2011

SP 500 declined 4.78%

All SPX Options

Spread Between Bid and Ask	2.87	SP 500 Points
Average bid Size (in contracts)	53.86	Contracts
Average Ask Size (in contracts)	79.09	Contracts
Average Trade Size (across all option series in sample)	1.91	Contracts

SPX Options with 23-37 Days to

Expiry

Spread Between Bid and Ask	2.15	SP 500 Points
Average bid Size (in contracts)	54.37	Contracts
Average Ask Size (in contracts)	102.2	Contracts
Average Trade Size (across all option series in sample)	4.12	Contracts

August 10. 2011

SP 500 declined 4.42%

All SPX Options

Spread Between Bid and Ask	3.04	SP 500 Points
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Average bid Size (in contracts)	31.80	Contracts
Average Ask Size (in contracts)	55.82	Contracts
Average Trade Size (across all option series in sample)	1.61	Contracts

SPX Options with 23-37 Days to**Expiry**

Spread Between Bid and Ask	2.58	SP 500 Points
Average bid Size (in contracts)	26.39	Contracts
Average Ask Size (in contracts)	50.30	Contracts
Average Trade Size (across all option series in sample)	3.12	Contracts

August 18. 2011

SP 500 declined 4.46%

All SPX Options

Spread Between Bid and Ask	2.70	SP 500 Points
Average bid Size (in contracts)	52.47	Contracts
Average Ask Size (in contracts)	112.73	Contracts
Average Trade Size (across all option series in sample)	2.02	Contracts

SPX Options with 23-37**Days to Expiry**

Spread Between Bid and Ask	2.38	SP 500 Points
Average bid Size (in contracts)	57.31	Contracts
Average Ask Size (in contracts)	70.28	Contracts
Average Trade Size (across all option series in sample)	5.05	Contracts

February 5. 2018

SP 500 Declined 4.1%

	Time					
	<u>8:30-9:50</u>	<u>9:51-11:09</u>	<u>11:10-12:29</u>	<u>12:29-1:48</u>	<u>1:49-3:15</u>	Average
<u>All SPX Options</u>						
Spread Between Bid and Ask	4.52	4.06	4.49	5.48	9.89	5.69 SP 500 Points
Average bid Size (in contracts)	125.85	132.74	119.85	98.8	51.3	105.71 Contracts
Average Ask Size (in contracts)	153.69	152.84	127.12	104	50.5	117.63 Contracts
Average Trade Size (across all option series in sample)	0.62	0.3	0.42	0.6	0.67	0.52 Contracts

SPX Options with 23-37**Days to Expiry**

Spread Between Bid and Ask	3.42	3.4	3.38	4.57	9.32	4.82 SP 500 Points
Average bid Size (in contracts)	121.71	135.1	131.9	83.6	36.3	101.72 Contracts
Average Ask Size (in contracts)	150.66	151.9	116.6	80.1	34.4	106.73 Contracts
Average Trade Size (across all option series in sample)	0.45	0.34	0.39	0.47	0.65	0.46 Contracts

155. As with the overall VIX standard deviation before, the tables above demonstrate that SPX Options trading on February 5th was aberrational compared to prior instances where the S&P 500 had experienced similar drops – and all in ways that are suggestive of market manipulation.

156. For instance, the spread between bids and asks on February 5, 2018 averaged 5.69 S&P 500 points across all SPX Options, and 4.82 S&P 500 points across those SPX Options that were within the 23-37 day expiration window that are included in the VIX calculation. These spreads are twice as high as the spreads on the three August 2011 days in which the S&P 500 suffered similar losses as February 5, 2018 – which would have resulted in a correspondingly

higher VIX when mid-points of these bid-ask spreads were calculated for out-of-the-money SPX Options.

157. February 5, 2018, however, saw average trade size (measuring trades that actually occurred) drop to levels that were one-third to one-ninth as small as the average trade size on the August 2011 dates. This, again, is predictive of manipulation occurring, as would-be manipulators would attempt to push up bid-ask quotes without actually putting premium at risk by executing trades (and/or by spoofing the market).

3. A comparison of bid-ask offers on SPX Options from February 5, 2018 demonstrates a high degree of similarity to past instances of manipulation.

158. Finally, LJM (with the assistance of its retained experts and consultants) reviewed public order data for SPX options with expiration dates between 23 and 37 days on February 5, 2018 – the options that were included in the VIX calculation – and used an automatic surveillance software created by Trading Technologies known as “TT Score” to analyze it.



159. The TT Score trade compliance software uses machine learning technology to identify patterns of trading behavior that may pose regulatory risk, and is designed to identify certain types of disruptive market activity, including spoofing, layering, abusive messaging, momentum ignition, pinging, and phishing.

160. TT Score organizes market data into clusters of activity based on factors such as time, trader, instrument, and proximity of other order actions, and calculates a “similarity score” that compares the data being analyzed to past regulatory actions. A similarity score is generated for each cluster on a scale of 0 to 100. A score of 100 indicates a high degree of similarity to patterns that have drawn regulatory attention in the past as being manipulative, while a score of 0 indicates a very low degree of similarity.

161. Beginning with the March SPX 2650 put and March SPX 2650 call (chosen because the 2650 strike price was near the prevailing S&P 500 price on the afternoon of February 5) as a baseline, LJM used TT Score to analyze 98 separate SPX weekly options (primarily weekly options that expired between 23-37 days from February 5th) that included strike prices between 2600 and 2800.

162. In the table below are the results of that TT Score review, with information regarding: (a) Instrument; (b) Expiration type; (c) Strike Price; (d) Put/Call; (e) number of clusters of activity analyzed for each option; (f) a minimum risk score showing the lowest similarity score derived from the analysis; (g) a mean risk score showing the average similarity score derived from the analysis; (h) median risk score showing the middle value similarity score derived from the analysis; and (i) maximum risk score showing the maximum similarity score derived from the analysis:

TT SCORE OUTPUT

 Denotes Score Over 50
 Denotes Score over 70

Instrument	Type	Strike Price	Put/Call	No. of Clusters	Minimum Risk Score	Mean Risk Score	Median Risk Score	Maximum Risk Score
SPX	Weekly	2800	Call	274	1	36	43	100
SPX	Weekly	2800	Put	324	2	39	42	44
SPX	Weekly	2795	Call	272	1	36	43	65
SPX	Weekly	2795	Put	330	2	38	42	44
SPX	Weekly	2790	Call	275	1	36	43	65
SPX	Weekly	2790	Put	328	4	38	42	44
SPX	Weekly	2790	Call	275	1	36	43	65
SPX	Weekly	2790	Put	328	4	38	42	44
SPX	Weekly	2785	Call	265	1	37	43	67
SPX	Weekly	2785	Put	335	2	38	42	44
SPX	Weekly	2785	Call	265	1	37	43	67
SPX	Weekly	2785	Put	335	2	38	42	44
SPX	Weekly	2780	Call	255	3	38	43	84
SPX	Weekly	2780	Put	334	1	38	42	44
SPX	Weekly	2775	Call	248	4	37	43	55
SPX	Weekly	2775	Put	327	2	37	42	44
SPX	Weekly	2770	Call	240	1	37	43	55
SPX	Weekly	2770	Put	317	2	37	42	44
SPX	Weekly	2765	Call	239	1	37	43	43
SPX	Weekly	2765	Put	307	2	38	42	59
SPX	Weekly	2760	Call	232	1	38	43	44
SPX	Weekly	2760	Put	310	3	37	42	44
SPX	Weekly	2755	Call	229	2	39	43	44
SPX	Weekly	2755	Put	272	2	37	42	44
SPX	Weekly	2750	Call	249	2	40	43	100
SPX	Weekly	2750	Put	255	2	37	43	43
SPX	Weekly	2745	Call	223	3	40	43	58
SPX	Weekly	2745	Put	254	2	38	43	43
SPX	Weekly	2740	Call	244	5	40	43	43
SPX	Weekly	2740	Put	256	3	37	43	43
SPX	Weekly	2735	Call	265	5	40	43	44
SPX	Weekly	2735	Put	249	2	38	43	43
SPX	Weekly	2730	Call	290	5	40	43	68
SPX	Weekly	2730	Put	259	4	37	43	43
SPX	Weekly	2725	Call	296	2	39	43	44
SPX	Weekly	2725	Put	251	2	38	43	43
SPX	Weekly	2720	Call	302	1	39	43	44
SPX	Weekly	2720	Put	275	2	36	43	55
SPX	Weekly	2715	Call	313	1	39	43	44
SPX	Weekly	2715	Put	267	1	35	43	54
SPX	Weekly	2710	Call	321	2	39	43	44

SPX	Weekly	2710 Put	279	1	36	43	59
SPX	Weekly	2705 Call	309	3	39	43	44
SPX	Weekly	2705 Put	263	2	37	43	72
SPX	Weekly	2700 Call	316	2	30	43	44
SPX	Weekly	2700 Put	306	2	34	42	89
SPX	Weekly	2695 Call	306	3	39	43	44
SPX	Weekly	2695 Put	296	1	35	43	70
SPX	Weekly	2690 Call	304	5	38	43	44
SPX	Weekly	2690 Put	303	2	34	42	67
SPX	Weekly	2685 Call	314	2	39	43	44
SPX	Weekly	2685 Put	311	1	36	43	82
SPX	Weekly	2680 Call	313	1	39	42	44
SPX	Weekly	2680 Put	305	1	35	42	79
SPX	Weekly	2675 Call	316	1	39	43	44
SPX	Weekly	2675 Put	298	2	36	43	90
SPX	Weekly	2670 Call	322	2	38	42	58
SPX	Weekly	2670 Put	287	1	36	43	77
SPX	Weekly	2665 Call	319	5	38	42	53
SPX	Weekly	2665 Put	291	1	35	43	94
SPX	Weekly	2660 Call	322	3	38	42	60
SPX	Weekly	2660 Put	287	1	36	43	100
SPX	Weekly	2655 Call	335	4	38	42	69
SPX	Weekly	2655 Put	292	2	37	43	76
SPX	March	2650 Call	448	4	37	39	43
SPX	March	2650 Put	279	5	41	42	43
SPX	Weekly	2650 Call	355	4	38	42	87
SPX	Weekly	2650 Put	274	1	36	43	73
SPX	Weekly	2645 Call	349	2	37	41	44
SPX	Weekly	2645 Put	282	1	37	43	88
SPX	Weekly	2640 Call	362	2	36	43	72
SPX	Weekly	2640 Put	266	2	37	43	78
SPX	Weekly	2635 Call	353	4	37	43	83
SPX	Weekly	2635 Put	279	1	35	43	76
SPX	Weekly	2630 Call	362	2	36	41	100
SPX	Weekly	2630 Put	265	1	36	43	67
SPX	Weekly	2625 Call	333	2	37	42	44
SPX	Weekly	2625 Put	267	1	38	43	100
SPX	Weekly	2625 Call	347	1	37	41	44

SPX	Weekly	2625 Put	269	2	37	43	68
SPX	Weekly	2620 Call	322	2	37	42	52
SPX	Weekly	2620 Put	263	1	39	43	100
SPX	Weekly	2615 Call	321	4	37	42	45
SPX	Weekly	2615 Put	260	2	38	43	100
SPX	Weekly	2610 Call	254	4	38	42	44
SPX	Weekly	2610 Put	264	1	39	43	96
SPX	Weekly	2610 Call	336	2	37	41	44
SPX	Weekly	2610 Put	260	2	37	43	79
SPX	Weekly	2605 Call	348	2	37	41	44
SPX	Weekly	2605 Put	255	2	37	43	70
SPX	Weekly	2600 Call	295	1	37	42	44
SPX	Weekly	2600 Put	260	2	38	43	87

163. As the TT Score analysis above indicates, a large number of the options used in the calculation of the VIX on February 5, 2018 were subject to potentially manipulative conduct, with 27 options series having TT scores above 70 (including 7 with a maximum TT score of 100).

164. A few other factors in the TT Score are also indicative of manipulation. Recall that the Griffin Paper found (in part) that the VIX was being manipulated because of spikes occurring in out-of-the-money SPX options, particularly in those with greater influence on the VIX calculation – namely, deep out-of-the-money put options (which have greater weight in the VIX calculation formula).

165. Here, on February 5, we see precisely that pattern, as deeply out-of-the-money put options at 2650 and below (i.e. the right to sell the SPX at a level far below the 2650 level that the S&P 500 had already reached in the afternoon after a significant decline) are those with some of the highest TT Scores, while corresponding calls at those same strike prices (i.e. the right to buy the SPX at a level below where it is currently trading) do not display the same high maximum TT Scores. Indeed, the majority of maximum TT Scores above 70 in this analysis were from put options – precisely what you would expect in manipulation.

166. Additionally, we know that VIX did not begin to spike until late in the afternoon, when the S&P 500 had already experienced its significant decline and the S&P 500 was around 2650. If this late afternoon spike in the VIX was the result of manipulation, we would expect higher TT Scores (indicating possible manipulation) present in lower strike prices near where the S&P 500 had fallen.

167. As the table above shows, that is precisely the pattern – lower strike prices (below 2650) that would have weighed more heavily in the VIX calculation that afternoon have higher TT Scores (higher indicia of manipulation) than the higher strike prices (above 2650) that traded in the morning when the S&P 500 was declining but volatility remained calm.

4. The VIX was manipulated on February 5, 2018, and this manipulation created artificial prices for instruments that LJM traded in, causing them losses.

168. As LJM's investigation above shows, (a) the VIX's rise on February 5, 2018 was statistically impossible absent manipulation; (b) SPX Options spreads and trade sizes on February 5, 2018 demonstrated patterns consistent with manipulation; and (c) statistical analysis using trade compliance software shows patterns of manipulation in precisely the out-of-the-money put SPX Options that one would expect to see if manipulation had occurred on February 5, 2018.

169. Furthermore, this evidence of manipulation is consistent with the patterns and means of manipulation of the VIX that had been (a) identified in the Griffin Paper; (b) described by market participants; (c) identified by an SEC whistleblower; and (d) punished in the past by the CBOE.

170. It is clear that on February 5, 2018, the market for SPX Options (and through them, the VIX) was manipulated by John Doe Defendants.

171. This manipulation caused SPX Options to be quoted and traded at artificial prices.

172. As SPX Options were quoted and traded at artificial prices, the prices of highly correlated instruments – specifically options on S&P 500 futures and E-mini S&P 500 futures – were themselves moved to artificial prices.

173. As a result of the John Doe Defendant's manipulation, LJM traded in options on S&P 500 futures and E-mini S&P 500 futures at artificial prices on February 5-6, 2018, in violation of the Commodity Exchange Act.

174. John Doe Defendants are therefore liable to LJM for the actual damages it incurred from trading in options on S&P 500 futures and E-mini S&P 500 futures at artificial prices on February 5-6, 2018.

175. While LJM cannot identify the John Doe Defendants at this time (as trading data in the SPX Options involved in the manipulation is confidential), information exists within the possession of CBOE sufficient to identify the John Doe Defendants. Once identified, LJM believes that additional information will be discoverable from the John Doe Defendants themselves regarding the extent of their manipulation, and the impact it had on prices in options on S&P 500 futures and E-mini S&P 500 futures.

V. CLAIMS FOR RELIEF

CLAIM ONE

Manipulation in Violation of the Commodity Exchange Act (Against John Doe Defendants)

176. LJM repeats and incorporates by reference each of the foregoing allegations of this Complaint.

177. Each Defendant, individually, in concert, and/or as one another's control persons or agents, through their acts alleged herein, specifically intended to and did cause unlawful and

artificial prices of options on S&P 500 futures and E-mini S&P 500 futures contracts in violation of the CEA, 7 U.S.C. §1 *et seq.*

178. The Defendants' manipulative conduct and trading activity alleged herein constituted a manipulation of the prices of options on S&P 500 futures and E-mini S&P 500 futures contracts on February 5-6, 2018, in violation of the CEA, 7 U.S.C. §§6b(a), 6c(a), 9(1), 9(3), 13(a)(2), and 25(a), as well as 17 C.F.R. § 180.2.

179. As a direct result of Defendants' unlawful conduct, LJM has suffered actual damages and injury in fact due to incurring losses when trading at artificial prices for options on S&P 500 futures and E-mini S&P 500 futures contracts on February 5-6, 2018, to which LJM would not have been subject but for the unlawful conduct alleged herein.

180. LJM was further legally injured and suffered injury in fact when it transacted in options on S&P 500 futures and/or E-mini S&P 500 futures contracts on February 5-6, 2018, in an artificial and manipulated market operating with the artificial prices caused by the Defendants.

181. LJM is entitled to its actual damages for the violations of the CEA alleged herein.

VI. PRAYER FOR RELIEF

LJM requests relief as follows:

A. That the Court enter an order declaring that Defendants' actions, as set forth in this Complaint, violate the law;

B. That the Court award LJM damages, treble damages, punitive damages, and/or restitution in an amount to be determined at trial;

C. That the Court issue appropriate injunctive and other equitable relief against Defendants;

- D. That the Court award LJM pre- and post-judgment interest;
- E. That the Court award LJM its costs of suit, including reasonable attorneys' fees and expenses; and
- F. That the Court award any and all such other relief as the Court may deem just and proper.

Dated: January 18, 2019

/s George A. Zelcs

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